

# Technology Review

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AUGUST/SEPTEMBER 1992

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**A L S O:**

***Electric Cars:  
On the Road Again***

***Making Cities Livable***

***The Simple Science  
of Seating***

***Gene Pharming***

***An Interview with  
John Sununu***

## The F-22

*An Exercise in Overkill*



# technology review

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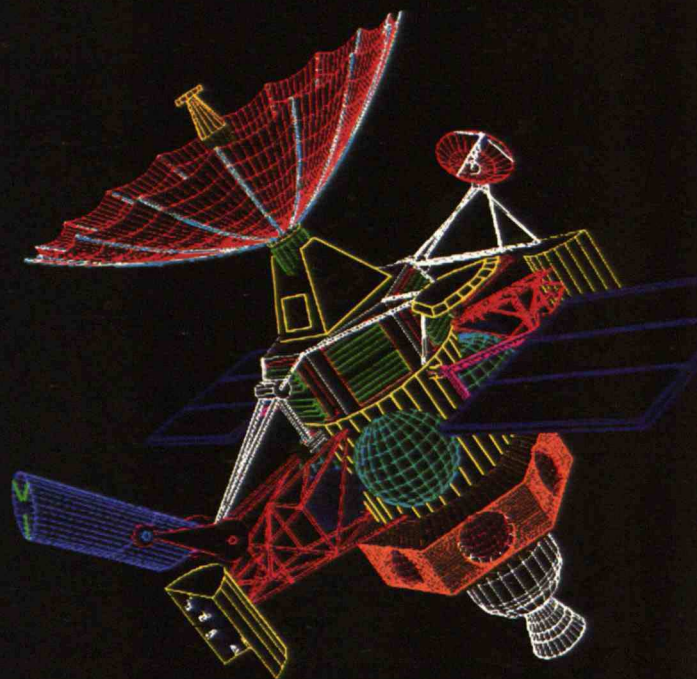
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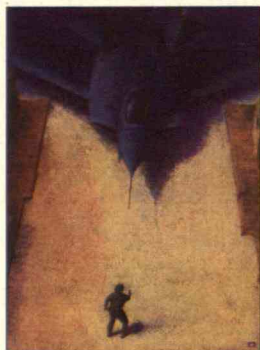
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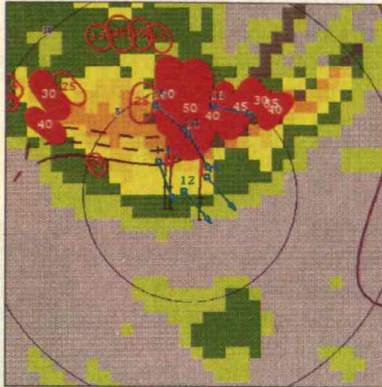
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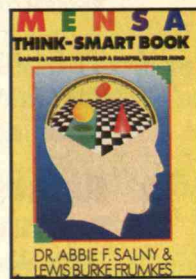
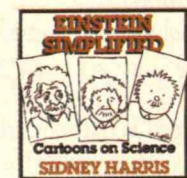
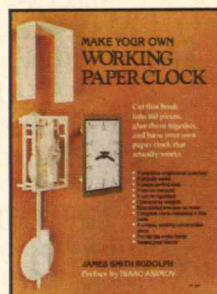
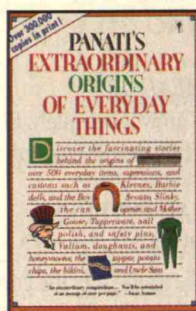
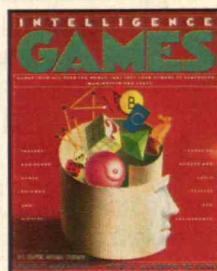
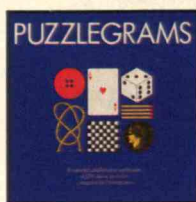
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# First Line

## America's Change of Life

THE American public has lately been educated on menopause—an experience that inevitably visits half the human race yet one that has long been taboo for discussion, even among women. Things change: now it's featured on the evening news, in the daily paper, as cover stories in news weeklies, and in bestselling books such as Gail Sheehy's *The Silent Passage*.

A ready explanation is that members of the baby-boom generation, having reexamined, in turn, other basic aspects of life such as adolescence, education, work, sexuality, and babies, now bring similar passion and resolve to the milestones they are beginning to encounter in their 40s.

At least that's the endeavor of the female half. But as with this cohort's previous innovations—the women's liberation movement, for example—the results will also be instructive to men, the country, and the world. Menopause has particular meaning for, of all things, the U.S. economic engine and its role in the global marketplace.

Men can continue to procreate, should they wish to, virtually to the end of their lives, but menopause poignantly reminds women that their childbearing years are over. They see it as a sign of “getting old,” and in our youth-oriented culture that usually means moving on, whether voluntarily or not, and especially when one's influence is already tenuous. Thus it has long been common for menopausal women to engage in denial, become depressed, lose self-esteem, and consequently remain uninformed and ill-equipped to deal with the transition and its aftermath.

But as Sheehy points out, menopause is not a disease. It's “a passage,” she says, “that is not cause for remorse but for celebration.” *Newsweek* notes that in traditional cultures, “women are revered in aging” and actually look forward to menopause. It is less a signal of

inexorable decay than of the beginning of a new, more mature, and even more productive phase of personal development. Having passed (or bypassed) the remorseful stage, the path is cleared for what Margaret Mead called “postmenopausal zest”—quite the opposite of what may have earlier seemed to be the end of the line.

In many ways, the economy of the United States has also been going through a “change of life.” And although the transition has not gone

*The nation  
is “getting old,” but  
its ultimate greatness  
may well lie ahead.*

unanticipated or unnoticed, we seem to have been dealing with it not unlike the way American women traditionally greeted menopause.

Some of *Technology Review's* authors have been discussing this phenomenon, though not literally from the above perspective. In the February/March 1992 issue, for example, economist Gar Alperovitz argued that although rapid growth certainly characterized the nation during times past, trying to jump-start the economic engine so that it will perform as it did in earlier days is futile and counterproductive.

The authors of two different articles in this issue—Langdon Winner and Donella H. Meadows—offer comparable perspectives. In “Farewell to Progress,” Winner suggests that the evolution of society—true progress—is not secured by relentless exploitation of natural resources, or by scientific breakthroughs and technological innovations alone. Instead, a more mature and strategic approach, one that consolidates assets in a long-term and equitable way, is warranted at our present stage of national life.

Similarly, Meadows differentiates between “dumb growth” and “smart development.” Growth means bigger—

quantitatively more; development means better—qualitative improvement. Just as individuals cannot remain youthful and grow forever, neither can societies, but all can continue to develop. Instead of desperately trying to “do something, anything, to prime the pump of growth,” says Meadows, we must concentrate our unique skills on what is sustainable and durable.

Such analysis may at first seem like gloom and doom, but it is actually optimistic, suggesting the possibility, even the likelihood, of a “postmenopausal zest” for the nation. Beyond the search for simple answers and desperate panaceas lies a more productive phase—“a new plateau of contentment and self acceptance,” as Sheehy puts it, and a “new perspective on life and humankind.”

The “development” approach is not without precedent in the United States. Witness the ultimately successful Cold War strategy of countering the Soviet Union's numerical superiority in military forces with sophisticated command and control systems and “smart” weapons. In another sphere—one that is more benign and commercial—knowledge-based approaches can be put to work protecting the environment while stimulating the economy. The Bush administration has not figured it out yet, but the public increasingly understands that controlling pollution doesn't necessarily mean high costs or premature industrial retirement.

The United States is technologically mature enough to design products, production processes, and patterns of use and reuse so that pollution isn't produced in the first place—for example, with byproducts that are not “wastes” but inputs to other processes—and with the whole hullabaloo being downright profitable. To do so requires taking the concept of smart development—operation in a “sustained yield” mode rather than one of “harvest to depletion”—more seriously. At its present stage of life, the country is quite capable of some zestfulness along those lines. ■

—STEVEN J. MARCUS—



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# Letters



## WOMEN'S SCIENTIFIC LEGACY

In "A World Without Women" (*TR May/June 1992*), David F. Noble observes that the women scientists of our own era face the same ill will that dogged our medieval predecessors. I certainly wouldn't argue with that. But harsh discriminatory treatment began long before the Middle Ages, and in spite of the hostility and barriers, women have worked in science and engineering throughout history.

In ancient Greece, for example, there were numerous women in Plato's academy, the site of the most important mathematical work of the fourth century B.C. However, they had to defy a law forbidding women to attend public meetings. Another example: the last great scientist of antiquity was a woman, Hypatia of Alexandria, but she died as a martyr to science at the hands of a mob—which could not have encouraged other women to follow her independent way.

In the medieval world, the church was indeed dominated by men, but there were large numbers of women in convents, which were centers of learning. Some of these women had positions of significant influence in the church hierarchy, and some were important scholars as well. In fact, Hildegard of Bingen, a German abbess who lived during the twelfth century, authored what have been called the greatest scientific works of the Middle Ages. Hildegard, an authority in the

medical sciences, was the most distinguished naturalist of her century. She traveled throughout Germany and France to teach about science, medicine, and theology in monasteries and other church institutions.

Herrad of Landsberg, another abbess, was noted as a teacher of all medieval academic subjects, including medicine and the sciences, and she built a large hospital and served as chief physician. Herrad wrote one of the earliest encyclopedias, portions of which have survived in copied form to provide us with much of our knowledge of the technology of the Middle Ages. Finally, Heloise, better known as the heroine of one of the most famous love stories of all time, was the most learned female physician in France during the twelfth century.

Noble's remarks about the execution of women as witches are on the mark. One of the prominent early European women in engineering suffered this fate: France's first mining engineer was a woman, Martine de Beausoleil, and she was imprisoned for witchcraft and died in prison in 1642, the year Galileo died and Newton was born.

CAROLINE L. HERZENBERG  
Argonne National Laboratory  
Argonne, Ill.

## DISPOSAL BY INJECTION

"Unwelcome Exports" by Frank Popper (*TR April 1992*) is inaccurate and misleading. While it is a fact that American Cyanamid's Fortier plant in Westwego, La., does release the largest amount of hazardous materials in the state, 99 percent of the waste is disposed of by deep well injection, which is regulated and permitted by the Environmental Protection Agency (EPA) and state agencies. This method safely and effectively disposes of waste several thousand feet into subsurface geological formations. EPA's Office of Solid Waste and Emergency Response recently determined that deep well injection is among the safest waste-management methods available.

It is also worth noting that in October



1990, the EPA granted the Fortier plant's application for an exemption to the land disposal restrictions imposed by the 1984 Resource Conservation and Recovery Act. We proved that we met the requirements of federal codes, and we demonstrated that there would be no migration of materials from the waste disposal area for 10,000 years. There is no way that the waste could ever "drift to Florida, degrading the environment," as Prof. Popper suggests.

PAUL D. MOGOLESKO  
Manager of Manufacturing Services  
American Cyanamid Co.  
Wayne, N.J.

*The author responds:*

When I wrote of toxic chemicals that would drift to Florida, I was clearly referring to the collective air pollution, water pollution, and hazardous waste from four plants, two apiece in Louisiana and Texas. The Westwego plant is but one of the four.

Also, I am happy to hear that the Westwego plant received the EPA exemption in 1990. But my article explicitly stated that I was using EPA's 1989 data, which were then the latest available.

### HIGHER PRIORITY FOR TEACHING

In "Reforming Freshman Science" (*TR Forum*, May/June 1992), Sheila Tobias correctly points out that teaching in introductory college science courses is generally so uninspired that it discourages students from majoring in the subject. She stops short of suggesting why science teaching is so bad, but it does not seem too hard to understand: most undergraduates attend universities that give a much higher priority to research than to teaching. Even when universities pay lip service to teaching, the academic reward system gives little weight to it, and this is especially true in science and engineering, where outside research grants provide significant returns to the university.

However, the worst result of this situation may be the general decline in scientific literacy rather than the proclaimed shortage of scientists. After all, the

future of the American economy depends on the ability of the work force to deal with technology. Thus, it might be more worthwhile to analyze college survey courses in science rather than the introductory courses aimed at prospective science majors.

MARK GOODMAN  
Center for Science and  
International Affairs  
Harvard University



### BLUE IN '92

Unlike Edwin Diamond and Jane Newman ("The Candidates and the Issues," *TR May/June 1992*), I have seen very little "genuine public-policy dialogue" in this year's presidential race. The situation is so pathetic that Ross Perot has offered like a modern Don Quixote to save the country.

MOSES CAMMER  
Waban, Mass.

### MULTIMEDIA COLLABORATION

In "Being There: The Promise of Multimedia Communications" (*TR May/June 1992*), David Brittan succinctly presents some of the key commercial and research systems aimed at facilitating collaborative activities. But the article focuses on technologies that support synchronous collaboration—for example, face-to-face meetings or shared drawing surfaces—though in fact much collaboration occurs asynchronously, as when authors review one another's papers. Interestingly, too, asynchronous tools have not been adopted widely in the workplace,

despite the fact that they demand less technological infrastructure.

Why is this so? Perhaps developers need to be more in tune with individual work patterns, group dynamics, and social networks. These types of issues have not been major factors for software applications designed for individual users performing individual tasks.

GEORGE FITZMAURICE  
University of Toronto

### FUNDS FOR FLYING

In "Building a New Economic Order" (*TR April 1992*), Ann Markusen and Joel Yudken show that they simply do not understand the commercial aircraft industry.

For one thing, the success of the industry is not a "direct result of massive public commitment," as they indicate. While government R&D has helped, it is not solely responsible for everything that has happened. Witness the many U.S. industries that have had considerably more federal help and are nevertheless fading from the scene.

Also, citing 3,652 Defense Department "rescue operations" of companies hardly proves a point. Only one of these supposed bail-outs had anything to do with aerospace anyway. And as for Lockheed's \$350 million loan guarantee, it came not from the Pentagon but from the Treasury. Finally, the United States did indeed build many planes during World War I, but they were only 6 percent of the total; France and England built 60 percent. What does that prove—that countries at war defend themselves?

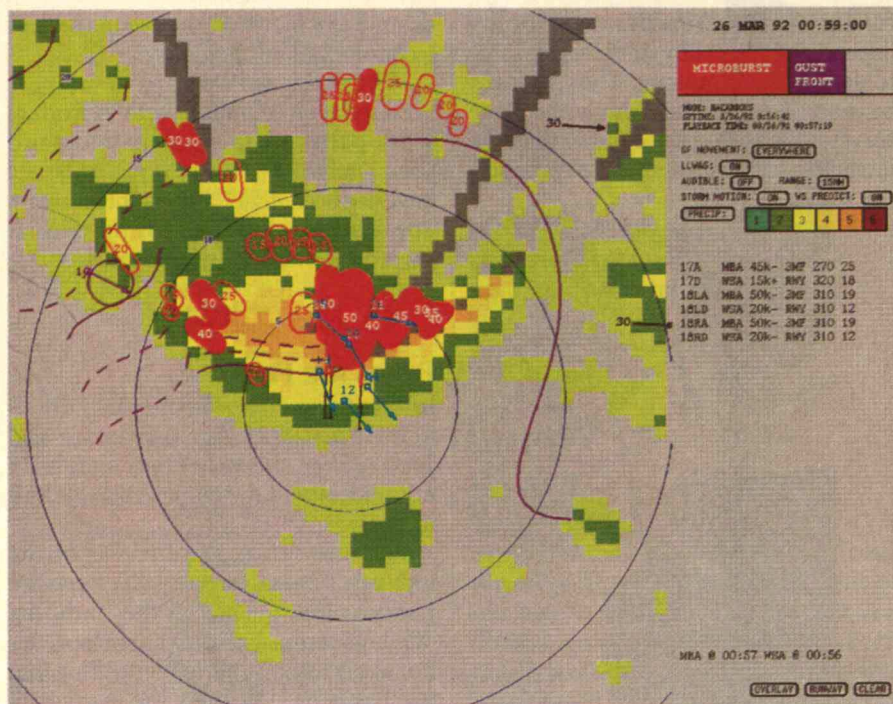
R.J. WALDMANN  
Director of Government Affairs  
Boeing Commercial Airplane Group  
Seattle, Wash.

#### Correction:


In "A World Without Women" by David Noble (*May/June 1992*), the illustrations on pages 55, 56, 58, and 60 were incorrectly credited. The correct sources are: pages 55 and 58, Bibliothèque Nationale, Paris; page 56, Oslo/London, The Schøyen Collection, MS.27; page 60, Giraudon/Art Resource, N.Y.



# MIT Reporter



## DETECTING ILL WINDS

 Later this year, 47 airports around the country will begin installing new computerized radar systems developed by MIT-affiliated Lincoln Laboratory and the National Center for Atmospheric Research. Called terminal Doppler weather radar, the systems are designed to detect small-scale, short-duration meteorological events called microbursts—wind patterns believed to have caused at least 30 airliner crashes and more than 500 deaths since the 1960s.

The key to detecting microbursts as they form is an expert computer system that analyzes data from doppler radar, which can accurately detect wind speeds at different distances from the runway. It uses the same principle as police radar guns—analyzing the change in frequency of a radio echo from moving objects, in this case particles carried by the wind. The system can give 10 to 20 minutes of warning about potentially lethal downdrafts, enough to divert aircraft on final approach to an airport.

A microburst, which typically is less

*Air-traffic controllers in Orlando have been using an expert computer system to alert approaching aircraft to dangerous local patterns called microbursts (solid red).*

than two miles wide, resembles a spout of water from a garden hose pointed straight down: a stream of cold air falls rapidly toward the ground, where it spreads outward and bounces back up.

An airliner flying through a microburst encounters a stiff headwind from the outward airflow, then a severe downdraft, and finally a tailwind. Unless a pilot knows what to expect, the initial headwind prompts exactly the wrong response: the pilot tilts the plane's nose downward to cancel the heightened lift. That reaction amplifies the downdraft's effect; if the plane is close to the ground, the result can be a collision.

That is exactly what happened to a Delta jet that crashed at Dallas-Fort Worth airport in 1985, killing 137 people in probably the best-known case of an accident caused by a microburst.

The power of the new doppler radar system was dramatically demonstrated the first week after a prototype was

installed at Denver's Stapleton airport in 1988. As five United jets approached the runway in a row, the system revealed an 85-knot microburst forming in their path. The alerted planes veered off and circled until the wind—one of the strongest microbursts ever detected—had dissipated. "We got off with a big bang," says James Evans, head of the weather sensing group at Lincoln Lab.


Prototypes installed in Kansas City and Orlando have helped hone the systems to be installed this year. For example, because of central Florida's stormy weather, the Orlando setup initially provided many overly conservative warnings that "pilots started to ignore," says Evans.

The first test systems relied on an expert meteorologist monitoring the doppler radar screen for conditions that might produce a microburst. What has made full-scale implementation possible is a computerized expert system that can automatically analyze the weather and provide readily understood displays for air-traffic controllers to relay to pilots.

Obstacles near some airports may produce spurious radar echoes that can cause confusion in the system, says John Mazor, spokesperson for the Air Line Pilots' Association. The group maintains that a combination of technologies, including an onboard detector under development, could be the best strategy to avoid microburst accidents. Still, he says, the doppler system is "going to be a very significant improvement" over today's detection abilities.

—DAVID L. CHANDLER (*The author is a science reporter for the Boston Globe.*)

## DESIGNING BETTER TANKERS

 The oil spilled from the *Exxon Valdez* may have mostly faded from sight along the Alaskan coastline, but it has left a still-visible mark on the shipbuilding industry that could lead to safer ships.

The outcry that followed the supertanker's 1988 grounding prompted Congress to pass the Oil Pollution Act of



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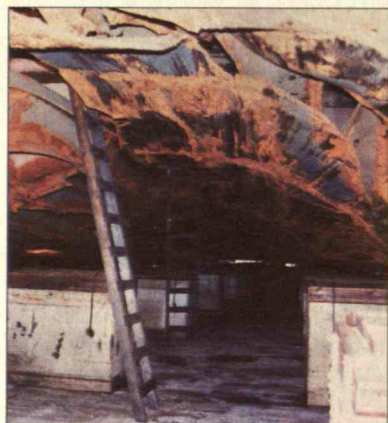
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*Research models produced by MIT's Joint Industry Project on Grounding Protection of Tankers predict the damage that occurs when ship hulls hit rocks. These photos show the post-accident hull of the Exxon Valdez.*

1990, requiring oil-carrying vessels operating in U.S. waters to be equipped with double hulls by the year 2015. If the outer hull is breached, the thinking goes, the inner one will prevent any oil loss.

Yet a handful of other designs could provide similar—possibly even better—protection, says Tomasz Wierzbicki, director of MIT's Joint Industry Project on Grounding Protection of Tankers and professor of applied mechanics in the Department of Ocean Engineering. The new program, which so far includes among its members some seven organizations that conduct shiptesting (such as the U.S. Coast Guard, Mitsubishi Heavy Industries, and ARCO Marine, Inc.), is developing models for predicting how

much damage different tanker designs sustain in grounding accidents.

There's no doubt that double-hulled tankers can provide extra protection against oil spills. In a "low-energy" grounding, for example, in which a ship barely scrapes over an underwater reef, the outer hull may be punctured by sharp rocks but the inner hull, nestled six feet or more within the outer skin, remains intact.

But sometimes a double-hulled ship can hit a rock or reef that will rip both hulls apart, says Wierzbicki, poking his fist through the cardboard bottom of a model ship for emphasis. Because of pressure differences, the unobstructed oil will flow out until its pressure equals that of the water.

Here's where another design may help. The intermediate-deck design, which has been championed by Japanese shipbuilders, consists of a fluid-tight deck that divides the inside of a ship into upper and lower compartments. The oil is kept in both parts, with the lower section below the ocean sur-

face. If the ship runs aground and that compartment is punctured by striking an underwater object, water should flow in instead of oil spilling out, limiting losses to whatever crude sloshes out when the ship rolls from side to side or pitches forward, or if falling tides lower the water level.

Boat builders have also come up with two other techniques to reduce oil loss. One that isn't favored among shippers would require them to stop adding oil to storage tanks before they reached capacity, so that the oil level would remain below the water level in event of an underwater grounding. The other method relies on a pump to create a vacuum above stored oil so it can't spill out.

To help industry and government determine the relative effectiveness of different designs, Wierzbicki's group is studying how individual hulls respond when fractured by different types of grounding accidents, one of the most common kinds of accidents in U.S. waters. For starters, the researchers are splitting flat pieces of metal with thick, sharp wedges, mimicking what happens when a hull runs into a rock. From this the group is developing three-dimensional "fracture-analysis" models that consider how metal crumples and curls as it is ripped apart—an improvement over the two-dimensional models developed elsewhere, according to Wierzbicki.

Although the models are so far very simple, some come close to predicting actual damage, he says, noting that the *Exxon Valdez's* single hull "peeled away like a sardine can." Further research will involve blunting and shaping the metal wedge so that it acts more like rock and putting metal stiffeners on the "hull" so that it more closely approximates the real thing.

Meanwhile, researchers elsewhere are studying other factors concerning tanker safety. For example, engineers at the U.S. Navy's David Taylor Model Basin research center in Bethesda, Md., are simulating how oil leaks when oil-carrying tankers hit underwater obstructions. In one test, workers positioned scale



models of oil-filled intermediate-deck and double-hulled tankers in a huge circulating water channel and punctured their hulls. Water conditions were varied to simulate tidal changes, calm and choppy seas, and ship movements.

Oil leaked from both designs, but in varying amounts depending on conditions, says William G. Day, who coordinated the experiments. For example, when an outgoing tide dropped a ship at anchor onto the anchor or the equivalent of a reef, creating a large puncture, the intermediate-deck design tended to spill less oil. The double-hulled design fared well with modest punctures. With a deep rupture, the ability of this design to keep some oil depended on whether supporting panels between the two hulls guided oil into sheltered pockets.

Wierzbicki relates such oil-tanker studies to those on automobile crash-worthiness, a field in which he has worked as a consultant for the last 10 years. Researchers studying tanker designs have their work cut out for them, he says: "Automobiles are so much further ahead in crash protection."

But the gap may be closing. Assigned responsibility for implementing the Oil Pollution Act, the Coast Guard recently requested that Congress fund further study comparing the double-hull and intermediate-deck designs. The modeling could also prove useful in light of a ruling by the U.N.'s International Maritime Organization that all newly ordered oil tankers have an effective pollution-control design in event of a collision or grounding. —P.J. SKERRETT

## PROTECTING E-MAIL



Electronic mail can transmit hundreds of pages to just about anywhere in only a few minutes. Yet most people hesitate to use the e-mail option for sending sensitive information such as financial reports, letters of recommendation, and job applications.

That's because most e-mail has "the same security level as a postcard," says Ronald L. Rivest, professor of computer science at MIT and a pioneer in the field

of data security. While a user often needs a password to send e-mail, there are typically no barriers to entering e-mail programs on others' computers and reading their mail. And forging e-mail "signatures" is relatively simple.

But users of Internet, an international network linking universities, corporations, and research sites, will soon have access to programs that make their communications much more secure.



*Ronald L. Rivest, professor of computer science at MIT, helped popularize public-key cryptography, which will be used to make electronic mail more secure.*

"Privacy-enhanced mail," or PEM, relies on public-key cryptography, a field popularized more than 10 years ago by Rivest and two other researchers, Adi Shamir and Leonard M. Adleman, then at MIT. Under such a system, every user is given two numbers, known as keys, that lock and unlock computerized messages: a public key that may be freely distributed, and a private key that is kept secret.

A user can send secure mail by typing in the recipient's public key. Since the recipient then has to apply his or her private key to decrypt the message, only that person can read the message. The system can also verify the sender's private-key signature; the recipient can unlock it using the sender's public key.

The system is based on the assumption that it is exceedingly difficult for an outsider to identify someone's private key. For example, the Rivest team's cryptography algorithm—which is expected to be widely used in privacy-enhanced mail programs—relies on products of prime numbers, which are divisible only by themselves and one. Since the sequence of digits in each key is longer than today's high-end worksta-

tion computers could probably crack in a year, chances are exceedingly low that an outsider could identify a key. As computers get faster, the keys can be lengthened to keep forgeries difficult.

After deliberating for roughly five years, this summer the Internet Architecture Board—which makes the decision on what kinds of programs can be used on Internet—is expected to offer final guidelines for software companies and others interested in writing PEM programs. Built into the system will be different options for digital signatures.

One will focus on "personas," which could become the electronic equivalent of CB handles, says Steven T. Kent, a computer scientist at Bolt Beranek and Newman of Cambridge, Mass., and chair of the Internet Activities Board's committee devising the PEM guidelines. By itself, a persona would not be traceable to a given person—a worthwhile condition if the sender does not want to reveal his or her identity while using an electronic bulletin board, say, or reporting a crime electronically. Personas could also let a group make its conversations public without jeopardizing individuals' privacy.

Another digital-signature option could be desirable to executives and others who want to sign their outgoing mail and not worry about their names being forged on others' mail. Legitimate users would give some proof of their identities when they applied for private keys. Then, every time such a person sent e-mail, a note would be automatically attached to the main message indicating the extent to which its sender had verified his or her identity.

If e-mail users embrace the idea of privacy-enhanced mail, MIT could be the largest site to offer PEM services initially, according to members of the Internet Architecture Board committee that has been devising the privacy-enhanced mail guidelines. But Jeffrey I. Schiller, MIT's computer-network manager, says users will have to learn about PEM's benefits, since many today already "assume that their e-mail is secure."

—REUVEN M. LERNER



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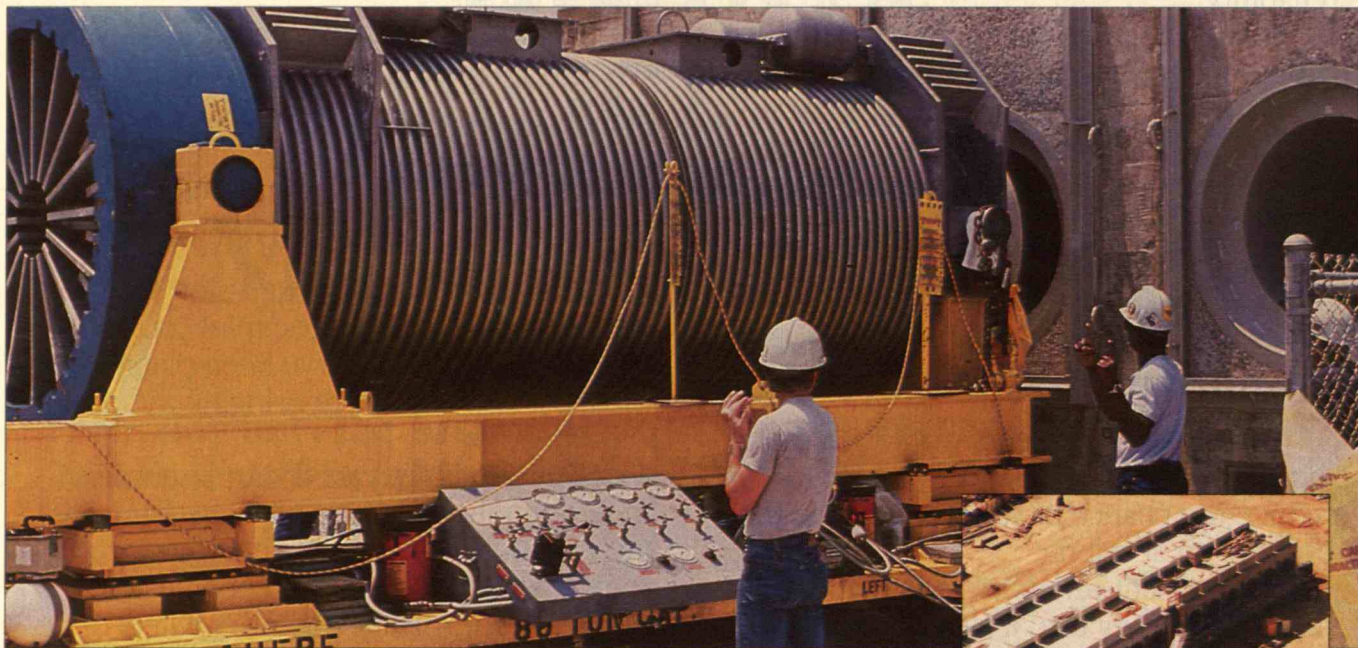


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# Trends



## Waiting Game for Nuclear Waste

At the Calvert Cliffs nuclear power plant in southern Maryland, 17 years' worth of spent fuel rods—some 366,000 in all—sit submerged in a cooling pool shared by the plant's two reactors. Like many other nuclear plants, Calvert Cliffs has received three separate permits from the Nuclear Regulatory Commission since 1978 to "re-rack" its highly radioactive spent fuel, allowing the so-called assemblies of fuel rods to be packed more densely into the pool than originally planned. But the NRC says that the Calvert Cliffs pool has reached capacity.

Plant representative Karl Neddenien explains that the Calvert Cliffs pool was initially designed to hold no more than 400 fuel assemblies, or roughly 80,000 rods—less than a quarter of the number now stored there. "By the end of this year," Neddenien says, "we won't have enough room in the cooling pool to discharge the fuel in the reactor core even if we needed to."

To varying degrees, the plight of the Calvert Cliffs plant is shared by nearly

all of the nation's older nuclear reactors. The high-level nuclear waste repository planned for Yucca Mountain, Nev., by the Department of Energy (DOE) has been delayed by at least a decade. No nationwide interim storage facility has yet been built. Yet the fission process that produces electricity in nuclear power plants results in a hefty residue of highly radioactive spent fuel rods—roughly 30,000 rods (or 30 tons) per year for each of the country's 100 reactors, a cumulative total that has now reached approximately 24,000 tons.

Almost all these spent fuel rods continue to sit in the cooling pools of the reactors where they were employed. In the late 1980s, government and industry researchers became concerned that these rods, if stored too closely together in the pools, could "go critical," causing a nuclear chain reaction. Further research indicated that the possibility of such a catastrophe is remote, which opened the way for even more densely packed pools.

Today scientists say that the spent fuel rods are sufficiently cooled by the water surrounding them to prevent an explosion. But they worry that the pools are bearing so much more weight than they were designed for that they could rup-



*Huge steel casks—containing thousands of spent nuclear fuel rods—must be stored in concrete warehouses near the H.B. Robinson plant in South Carolina (top) and the Calvert Cliffs plant in Maryland (inset), where in-house cooling pools are reaching capacity.*

ture, especially in the event of an earthquake.

Peter Soo, a researcher at Brookhaven National Laboratory who specializes in nuclear waste issues, says that, given these structural and space constraints, "some reactors will have to shut down" within the next six years unless the interim storage issue is addressed. Repository or none, the DOE is bound by law to assume responsibility for the high-level spent fuel at commercial nuclear reactors by 1998, Soo explains. But many reactors like Calvert Cliffs will reach the spent fuel bottleneck long before that date.



To help bridge the gap, some industry and government scientists are focusing on the prospects for storing spent reactor fuel in casks outside the cooling pools. The idea of cask storage is not new, but the prospect of widespread use by individual utilities is. The U.S. Council on Energy Awareness, a nuclear industry group, says that at least four utilities have applied for licenses to engage in some kind of onsite cask storage, and another eleven are formally investigating the possibility of enlarging their fuel pool storage.

The idea is basically simple: fuel rods are lifted by crane from the cooling pool and inserted into a sealed metal and concrete cask, which is then stored on site. Many designs have surfaced, including so-called wet casks, which are cooled with liquid inside; and dry casks, which would use the convection of air or other gases to keep the rods cool.

Such on-site storage arrangements surely lie ahead—Neddenien and his colleagues at Calvert Cliffs know that interim on-site storage is virtually their only option if they want to keep operating—but most industry analysts openly express their impatience. As Soo and others explain, the nuclear industry has for years paid into a fund to construct the government's repository. Now, on top of these disposal costs, utilities must assume the financial and technical burdens of interim storage as well. Many utilities will be unwilling or financially unable to assume the added costs of interim storage when their cooling pools reach capacity. For example, Neddenien says that his firm, Baltimore Gas and Electric, which relies on the two Calvert Cliffs reactors for some 40 percent of the region's electricity, will need to spend an additional \$30 million.

Meanwhile, the DOE's proposed Yucca Mountain repository, which was originally planned for completion by 1997, remains embroiled in controversy. The site is still in the "characterization" phase, which means that the DOE has yet to decide whether the location even meets the government's technical criteria.—SETH SHULMAN

## The Power of the (Oilseed) Press

Africa is littered with the rotting carcasses of abandoned technology-aid programs. From rusting high-tech farm vehicles to broken-down irrigation equipment, these crumbling contraptions provide mute testimony to the millions of dollars squandered on well-intended but inappropriate projects by the international aid community.

A recent project in Arusha, Tanzania, has shown how simpler technologies can have a much larger impact on the lives of local inhabitants. Originally regarded as an ugly duckling in international aid circles, a modest, single-operator, sunflower-oilseed press has doubled or tripled the incomes of hundreds of Tanzanians.

When the project began in 1985, Appropriate Technology International (ATI), a Washington, D.C.-based organization that partially funded the program, was pouring money into an unwieldy, one-ton oilseed press. Today, the organization brags about the success of its new 143-pound press and points to the 1991 Distinguished Appropriate Technology Award that it and engineer Carl Bielenberg received late last year from the U.S. National Center for Appropriate Technology.

Lynn Schleuter, director of the Village Oil Press Project in Arusha, realized the need for the press in the mid-1980s, when the border between Tanzania and Kenya was closed and the flow of consumer goods into Tanzania stopped. "There were

no matches, no toilet paper, no soap, no cooking oil," he recalls.

ATI located the only oil presses on hand in East Africa, but these 12-foot-tall, one-ton behemoths cost about \$2,000 apiece and were "absolutely hopeless," Schleuter says. Four people were required to operate the press. And preparing the seeds for pressing required four other pieces of equipment: a decorticator to remove the seed shells, a winnower to separate the seeds from the shells, a roller to crush the seeds, and a heater to bake them.

And the press had design flaws. Even though the shaft—along which the press mechanism moved—was made of high-carbon steel, its threads were not strong enough to withstand the 80 tons of force that the machine applied to press oil out

*When low tech works best: this single-operator oilseed press helped solve a devastating cooking-oil shortage in Tanzania after more elaborate designs failed.*





of the seeds. "The shafts broke down right away, and you needed foreign currency, which was impossible to get in those days, to import new ones," says Schleuter.

ATI dispatched engineer Carl Bielenberg, who, responding to requests for a simpler model, first designed a press that could be operated by two people pushing and pulling a long lever, which moved a small piston horizontally back and forth inside a cylinder. As the lever was pushed up, a few handfuls of sunflower seeds fell from a hopper into the cylinder. As the lever was pulled down, the piston compressed the seed into and through a conical, slatted pressing cage. The oil dripped from the cage as the seedcake was pushed out the end. Further modifications made it easy enough for one person—man or woman—to press seeds, which needed no preparation except cleaning and heating in the sun.

At \$260, the technology is affordable. It requires no costly diesel fuel or electricity to operate. It's easy to transport and repair. And it can be manufactured locally.

### A Mechanism for Success

The press has thus prompted the growth of a vital new economic sector. Tanzanians manufacture the presses and sell them for a profit. Farmers who buy the presses grow a crop that ensures them an income and provide employment for laborers. At present, some 500 presses annually squeeze out more than 100,000 gallons of an oil that is inexpensive, lasts for months without refrigeration, and can be reused several times.

The success of the program was clinched by people like Shadrack Pallangyo, a farmer living in Endakiso—a typical Tanzanian village of 4,500 people without electricity, running water, or paved roads—who jumped at the opportunity to earn extra money. After seeing a press operating in his wife's home village, Pallangyo borrowed money to buy one in 1987. He planted several additional acres of sunflowers and encouraged neighboring farmers to

do the same. In return for pressing their seeds, he kept half the oil.

Pallangyo discovered an unanticipated side benefit: he could sell the "cake"—the material that remains after squeezing the oil from the seed—as animal feed. Farmers claim that cows fed on sunflower cake produce twice as much milk. All told, Pallangyo tripled his annual income of about \$200 and repaid his loan in six months.

While the Tanzanian sunflower oilseed press project cost less than \$1 million over six years, similar technology is not working in Kenya, where the World Bank has allocated \$3 million for the project. There the program is administered through the Kenyan Ministry of Agriculture, which is studying the press and preparing to distribute it, rather than putting it in the hands of users. About a dozen people spend part of their time working on the project. Some are compiling a technological information packet for potential users and testing it with eight people over two seasons. They plan to improve the technology based on field experience and then develop promotional materials to disseminate the press.

The government ordered 90 presses built by a company that charged nearly \$1,000 apiece. But most of the presses are sitting in agricultural field stations for demonstration because people cannot afford to buy them and the government does not offer loans, an element vital to the success of the Tanzanian program.

The Tanzanian oilseed-press project has emerged as a model for other appropriate technology aid projects. In Kenya, for example, manual irrigation pumps have replaced those powered by electricity, petroleum, or diesel fuel, which are either unavailable in rural areas or prohibitively expensive. The pumps were designed to be built by local toolmakers and repaired by the farmers who use them. Even though the pumps can irrigate only about half an acre apiece, Kenyan farmers can earn enough from their vegetable crops to pay for a manual pump in a couple of growing seasons.

—JANE STEVENS

## The Truth About Dinosaurs

■ You've heard of Save the Whales, Save the Trees, and Save the Oceans, but Save the Dinosaurs? Though it sounds like they're some 65 million years too late, a worldwide coalition of scientists, artists, authors, and educators has banded together to do just that.

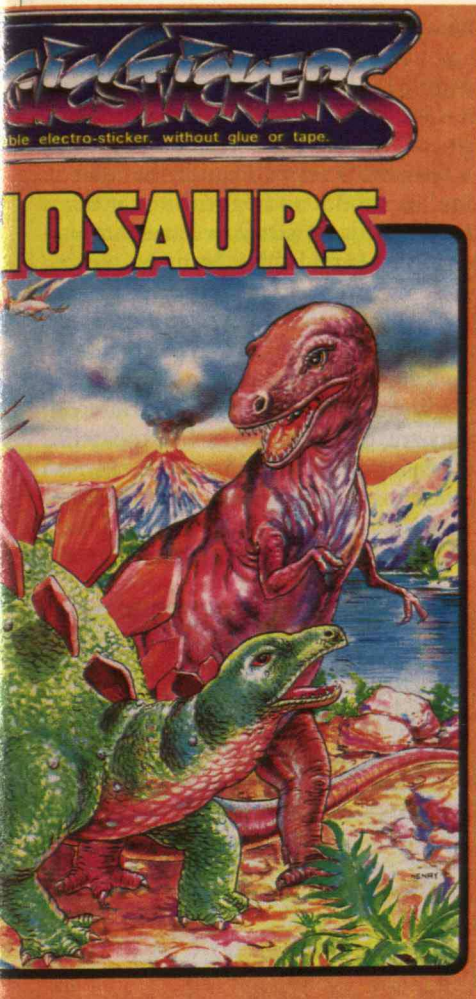
They've formed the Dinosaur Society, a nonprofit group dedicated to setting the record straight about everybody's favorite fossils. The problem isn't that dinosaurs have faded from memory. Indeed, they're everywhere these days—on sheets and shower curtains, at the movies and on TV, in books and games. But most of the information we get about dinosaurs is just plain wrong, says Don Lessem, president and founder of the group, based in Newton Lower Falls, Mass.

The media usually portray dinosaurs as pea-brained, ponderous creatures, whose big, heavy tails dragged through the swamps they inhabited. In fact, most dinosaurs were energetic, muscular, and held their tails off the ground. Yes, they lived in swamps, but they lived in woodlands, on deserts, and even in the arctic, too, says Lessem, a journalist and author of *Kings of Creation*, a new book about recent dinosaur excavations.

Dinosaurs weren't so dumb, either. "Dinosaurs had enough gray matter to do anything they needed to do," says dinosaur paleontologist David Weishampel, professor of anatomy at Johns Hopkins Medical School and vice-president of the Dinosaur Society. They had brains comparable to those of birds







or reptiles, which enabled them to form structured herds and hunt in packs.

Take the arms of the tyrannosaurus rex, one of the most popular dinosaurs among children. "They've always been thought of as useless vestiges," says Lessem. But when its actual forearms were discovered two years ago, researchers found that they were as short as human arms but three times as wide and ten times more powerful. Instead of having wimpy biceps, tyrannosaurus rex was really the Arnold Schwarzenegger of dinosaurs, with the strength to have curled 440 pounds.

Other recent explorations provide clues about dinosaur nesting behavior. "No one ever thought that these creatures were such caregivers to their

*What's wrong with this picture? Tyrannosaurus rex became extinct some 60 million years before stegosaurus existed. Such factual errors are typical of most dinosaur games, books, and toys.*

young," says Lessem. But regurgitated food found in dinosaur nests suggest that they were. Fossils of some baby dinosaurs support this idea, too: the babies' bones were unexpectedly soft, proving that they weren't strong enough to walk out of the nest and hunt for food on their own, he says.

Unfortunately, little of this new information filters down to today's budding scientists. "Kids learn about the same dinosaurs we heard about 100 years ago," says Lessem. They also miss out on the notion of science as a work in progress; to them, it seems like dinosaurs are a done deal, he says.

The reason behind all of the inaccuracy about dinosaurs is that the media haven't kept up with research, Lessem says. In fact, most of the knowledge we have about dinosaurs has been garnered only over the last 20 years. Even today, a new genus of dinosaur is discovered every seven weeks.

It's understandable, then, that authors and toy makers perpetuate misinformation about dinosaurs. "They could go to the public library, but they would be using books that themselves are out-of-date," says Weishampel. The most current findings are available only in obscure scientific journals.

### Dino Aid

This doesn't stop manufacturers from raking in billions from sales of inaccurate dinosaur products. But at the same time, funding for dinosaur research is virtually extinct. Less than \$1 million is spent worldwide each year on dinosaur research, and many field projects, exhibits, and publications are canceled for lack of funds.

The Dinosaur Society maintains a media and manufacturers' dinosaur database so that educators and makers

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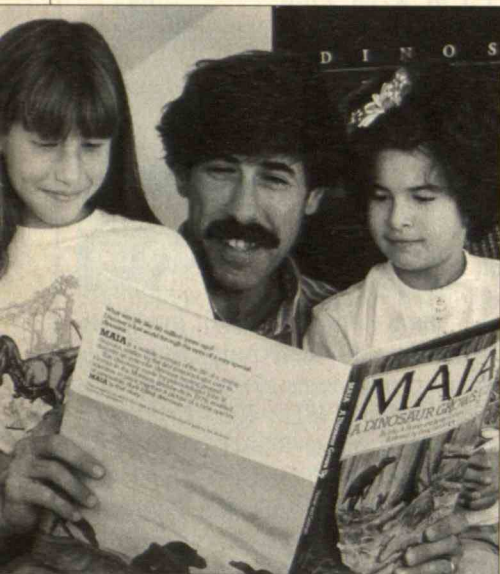
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*Because kids are not exposed to new theories about dinosaurs, they miss out on the idea of science as a work in progress, says Dinosaur Society president Don Lessem.*

of games, books, and toys will have access to accurate, up-to-date information. It is also planning to issue a seal of approval that would indicate that a particular dinosaur product meets its standards of accuracy.

From the proceeds of these activities and other donations, the society ultimately wants to fund individual research projects. So far, the group has already received applications from scientists who want to dig for dinosaurs in southern China, buy a new field vehicle for a site in Mongolia, excavate trackways in Australia, and study dinosaur eggshells in South America.

Dinosaurs are more than just a hook to get kids to pay attention in science class, says Lessem. "They are increasingly being seen as a mechanism for understanding evolution in general." Even though people sometimes treat them like dragons, unicorns, or other fantasy animals, what makes dinosaurs different is that they were real, he says. "That's why it's so important to get them right." —DEBRA ROSENBERG

## Let's Get Small

■ Ambler, a 12-foot-tall robot with six legs, was designed by Carnegie-Mellon University to sidestep crevices and large boulders on the moon. Robby, a three-section rover weighing more than a ton, was built by NASA's Jet Propulsion Laboratory (JPL) to explore other planets. And Mars Rover, a compact-car size vehicle developed in the former Soviet Union, recently roamed the flanks of Siberia's Kamchatka volcano in a test of its ability to negotiate the Martian landscape.

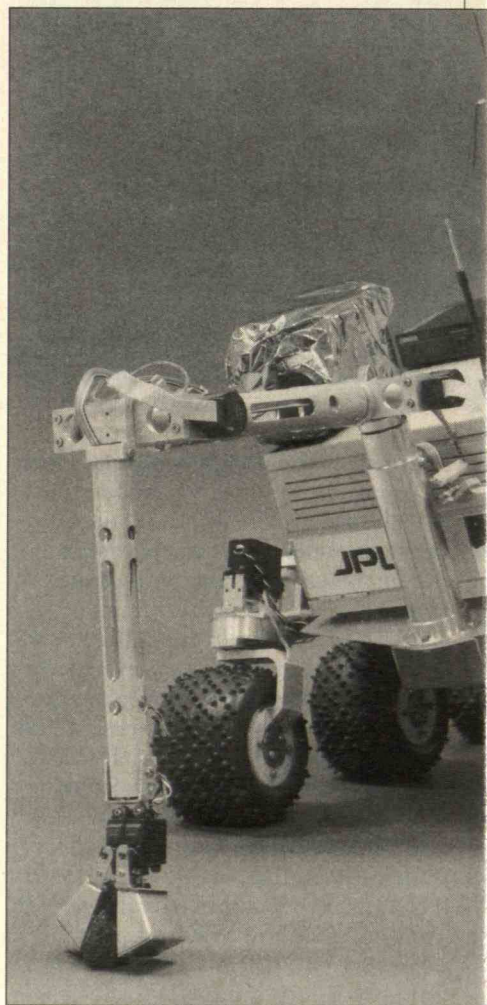
But while machines such as these have proven themselves able explorers on earth, they are about to be rendered obsolete by the next generation of robots, a battalion of smaller units that scientists believe are better suited to take the first steps on distant planets.

Why go small? "Sending one rover in one launch to explore a planet is a high-risk operation," says Colin Angle, vice-president of IS Robotics, one of more than a half dozen groups—including JPL, Martin Marietta, Hughes, and MIT—developing microtechnology for space robots. "But if you send 20 minirovers—each with a different function—you can cover much more terrain. And if some break, that's all right. Plus, the robots can work together: one can thump the ground while the others conduct seismographic experiments, for instance." Getting the lightweight robots into space will be cheaper and easier than launching larger payloads, he adds.

One of the more recent developments in minirobot technology is Rocky III, JPL's third in a series of rover models designed for a Mars mission. While Rocky I and Rocky II were crude and cumbersome models designed to test the basic mobility of car-size rovers on rough terrain, Rocky III is much smaller and more sophisticated. It weighs in at just over 52 pounds, and comes complete with a video camera (used primarily to allow a human operator to steer the unit) and a manipulator arm that can dig for soil samples. In a test run,

the minirover successfully worked its way across the Avawatz mountains south of Death Valley, where the terrain is similar to the two Viking landing sites on Mars.

Although Rocky III has proven that a smaller robot can negotiate boulder-strewn fields, it is still overweight and underequipped. "Right now, we're working on Rocky IV, a rover that is closer to what would be needed on Mars," says Giulio Varsi, manager of the Space Automation and Robotics Program at JPL. And though the dimensions are similar to Rocky III, Rocky IV will weigh only about 16 pounds, thanks to lighter-weight materials and miniature electronic components. For instance, Rocky IV abandons the heavy





rubber wheels of its forerunner in favor of lightweight steel wheels with cleats designed for sharp rocks and rough terrain. Also, instead of trying to dig with a large manipulator arm, Rocky IV will use a small chipper to cut through the top layer of the weathered Martian surface and a scoop to dig up soil. Its battery pack, camera, spectrometer, and other scientific instruments, such as a seismometer, will also be smaller and lighter.

As robot rovers continue to evolve, more emphasis will be placed on improving their autonomy, as no humans will be around to watch over them on their planetary expeditions. One JPL proposal calls for programming a map and predetermined route

into the robot's memory. But robots so equipped would not be able to adapt to unforeseen circumstances.

Another suggestion from scientists at JPL and elsewhere is for a computer-aided remote driving system. In this scheme, stereo pictures would be sent from the robot to a landing unit that would, in turn, transmit the signal to earth. There, a human operator viewing the robot's location on a stereoscopic display would manipulate a 3-D cursor on a screen to designate a safe path for the robot. With this kind of teleoperation, however, the robot would have to remain within range and view of the landing unit at all times and would require constant human monitoring and control.

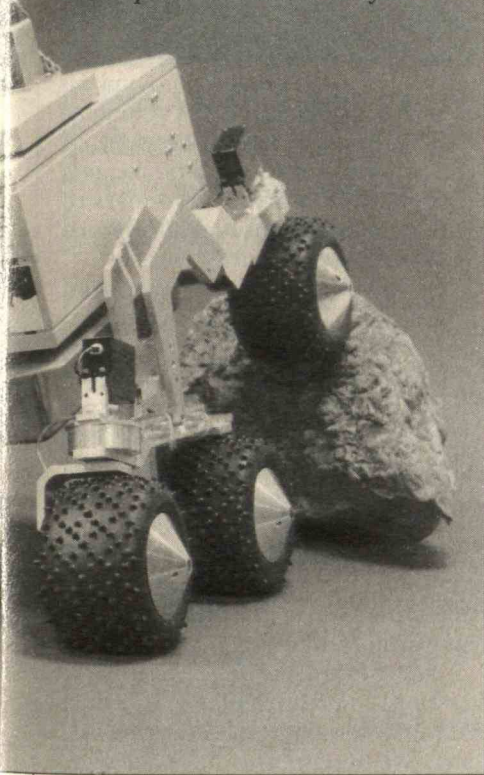
A more attractive solution entails programming a minirobot with a set of behaviors that would be activated or deactivated as the robot explores its surroundings. For example, a Mars rover might be instructed to check for carbon deposits in dry riverbeds by following all descending ridges to their lowest elevations. Or the program could instruct the robot to sample the soil and follow any deposit to its maximum concentration. Such behaviors would be tedious, if not impossible, to control by teleoperation alone.

Scientists hope that it may be only a decade before such lightweight creatures are scrambling *en masse* around the moon or Mars. In fact, says JPL automation technologist Carl Ruoff, "these minirobots have often been built from 'off-the-shelf' items," says Ruoff. "We could have a Rocky IV-type vehicle ready in a few years."

In the meantime, these miniature space robots, like the heavyweights that preceded them, may well be put to good use on earth. Past space robots have already spawned a host of spin-offs in remote-controlled mining (which has boosted production and removed miners from dangerous operations), detecting hazardous materials during fires and other emergencies, and cleaning up chemical spills.

—PATRICIA BARNES-SVARNEY

*Weighing in at 52 pounds, Rocky III—the latest in minirover technology—could explore boulder-strewn terrain at future Mars landing sites. But plans are already in the works for the sequel: a 16-pound unit dubbed Rocky IV.*



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*Waste white paper imprinted with thermoplastic inks from laser printers and photocopiers can usually be recycled only into tissue paper, cardboard, or other lower-grade sheets. But an innovative deinking technology,*

*which uses a carbonated pulp slurry to wash out the stubborn ink resins and float them to the surface in gas bubbles, allows Patriot Paper Corp.'s Boston mill to recycle white paper back to its original quality.*



## White Paper Recycling

The bad news is that the amount of white paper discarded by U.S. office workers is at an all-time high. The average business employee now throws out more than 250 pounds of such paper per year, while the average bank or insurance-company professional discards twice as much.

The worse news is that while many workers participate in paper-recycling programs, the white sheets they painstakingly separate from less expensive grades are of surprisingly little value to recycling mills.

The problem lies not with the white paper itself but with the thermoplastic inks applied by laser printers and photocopiers. Although these inks create wonderfully sharp images, their resins—which are electrostatically drawn onto the white sheet in powder form and then fused and fixed by heat or solvent vapor—are difficult to remove.

Until recently, in fact, white sheets imprinted in this way could be used by recycling mills to produce only lower-grade papers such as cardboard and tissue paper, which have less stringent deinking requirements. But a new deinking technology about to go on line at a recycling mill in Boston promises to make the removal of these stubborn resins a routine operation.

Standard inks, such as those from dot-matrix printers, typewriters, and pens, are easily removed by even the simplest washing-style deinking systems. After blending the waste paper with water to form a pulp, such systems siphon off ink particles as they rise with detergents to the top of the heavy pulp slurry. Unfortunately, these systems are incapable of removing the heavier thermoplastic ink particles, which tend to sink along with the pulp, making removal more difficult.

A key to extracting the heavier particles hinges on refinements to the more elaborate flotation-style deinking systems, which until now have achieved



only partial success. In typical flotation-style deinking, complex chemicals called surfactants—combinations of two molecular structures—are added to the pulp slurry. One end of the surfactant attaches itself to an ink particle while the other seeks out a gas molecule. Pumping gas bubbles through the pulp induces the surfactant, with ink speck in tow, to stick to a bubble and rise to the surface.

While such flotation devices are able to extract a greater number of thermoplastic ink particles than those captured in washing deinking systems, they have had difficulty removing the largest particles. Since the thermoplastic inks break down into a wide range of particle sizes, removing them requires

pumping bubbles of various sizes into the slurry.

A new flotation system, developed by Beloit Corp., increases the range of bubble sizes by pressurizing the slurry compartment to dissolve gas in the solution—a process akin to carbonation. The pressure above the liquid is then decreased at a controlled rate to release ever-larger gas bubbles in the liquid.

The new deinking module was recently installed in Patriot Paper Corp.'s Boston mill. When the plant becomes fully operational before the end of the year, it is expected to handle 220 tons of waste paper per day, 65 percent of which will be laser-printed and photocopied white paper. Patriot will then

become the first plant to fully recycle laser-printed office white paper outside Europe and Japan, where requirements for separating paper grades are more stringent.

"By pushing white waste paper to its highest use, demand for waste paper grows at all mills," says Jeffrey Lissack, recycling market director at the Massachusetts Department of Environmental Protection, "even those producing lower paper grades." If more mills like Patriot Paper go into operation, limited supplies of waste paper will be available to mills producing lower paper grades, and they will have to pay more for it. Therefore, Lissack believes, the overall economics of paper recycling are destined to improve.—SCOTT CASSEL

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# THE POLITICAL PLEASURES OF ENGINEERING

**I**T's personally frustrating to see people doing really stupid things when I know what should be done."

That's how John Sununu sums up the downside of working at the top levels of government. Sununu, who served as President Bush's chief of staff from 1989 until resigning under fire last December, was an anomaly in Washington: a high-level policymaker with a strong technology background. He earned bachelor's, master's, and doctoral degrees in mechanical engineering from MIT, and worked five years in industry helping to design electronic devices. He's not a dilettante.

Sununu combines a powerful optimism about technology with an equally powerful distrust of government. He sees a lot in Washington that he doesn't like—especially the political influence of people and organizations who profess concern for the environment but whose true mission, he contends, is to slow technological development and economic growth. As governor of New Hamp-



## *An Interview with* **JOHN SUNUNU**

THE FORMER  
WHITE HOUSE CHIEF OF STAFF  
DECRIES WASHINGTON'S  
TECHNOLOGICAL IGNORANCE,  
ATTACKS THE MOTIVES OF  
ENVIRONMENTALISTS,  
AND URGES HIS  
FELLOW ENGINEERS  
TO JOIN THE  
POLICY FRAY.

shire during the 1980s, he strongly favored construction of the Seabrook nuclear power plant, a project that many environmental groups opposed as unsafe and unnecessary.

Sununu is widely reported to have convinced President Bush that the threat of global warming was overblown, and that arbitrary limits on carbon dioxide emissions would have a cost vastly exceeding their benefit. Largely because of Bush's hard-line stand, the treaty signed in June at the United Nations Conference on the Environment and Development does not compel countries to lower their CO<sub>2</sub> emissions.

Sununu is also outspoken on a less partisan issue: scientists and engineers, he says, need to contribute more to the policymaking process—even though that might mean stepping off the career fast track. He exhibits a twinge of regret when he admits that his





*detour into politics means he can't easily resume his practice as a consulting engineer. "I'm 10 years out of date," he says. "I can't do cutting-edge work."*

*This leaves Sununu as a man without a clear next step. For the year to come, he will stay in Washington so that, he says, his son can graduate from a science and technology high school in northern Virginia. He also will continue—for the rest of this year, at least—to cohost Crossfire, a nightly news-oriented talk show on Cable News Network; Sununu is filling in for Patrick Buchanan as the show's conservative interrogator. He also plans to continue his consulting activities—not in doling out state-of-the-art technical advice, he says, but “helping companies make the best use of their R&D resources.”*

*Senior editor Herb Brody interviewed Sununu in his office a few blocks from the White House.*

**TECHNOLOGY REVIEW:**  
You have said too many people in government today don't have a good quantitative sense—they do not, for example, have an intuitive feel for the difference between parts-per-million and parts-per-billion. How has this led to bad policies?

**SUNUNU:** In many cases, we have established unnecessarily harsh regulatory requirements. There's the classic example of the Delaney Amendment, which requires zero levels of certain materials if they have ever been linked to cancer through even the remotest of studies. Zero is an awfully hard number to reach. But politically, it's easy for a policymaker to say that he has refused to allow any level of that material to get into anything that's accessible to the children of this country.

**TR:** Isn't that what regulations are for?

**SUNUNU:** A part per million is a thousand times as much as a part per billion. I would suspect that it's even more than a thousand times more expensive to get to part-per-billion levels than part-per-million levels. Yet there are folks up there in Congress who act as if there's not much difference between the two. And getting down to “zero” often isn't possible at any price.

**TR:** Where else do you think that politicians' technical naiveté is leading to bad policies?

**SUNUNU:** A debate is going on in Congress right now about automotive efficiency, and it's proceeding in a very narrow way. It focuses only on energy efficiency, without any good under-

standing that there are a host of interrelated aspects, including not just efficiency but also passenger safety and proper use of financial resources. A lot of politicians are saying, all we have to do is pick a number for automobile fuel efficiency, and the industry will eventually discover how to get there. That's not very realistic or constructive. You ought to design legislation and regulations to achieve a specific purpose, understanding how industry will or will not be able to comply with what you are demanding.

But I think that many environmentalists are looking not so much for energy efficiency as they are to stop development. In fact, a lot of the causes they've championed in the last couple of decades have had less to do with how to improve the environment and more to do with an antigrowth agenda.

**TR:** What make you so suspicious of their motives?

**SUNUNU:** Because the pattern keeps repeating. Look at the global warming debate, for instance. There is an effort to focus only on carbon dioxide emissions, and I think that's because carbon dioxide is virtually a surrogate for economic growth and development. There's opposition to imposing limits on a more comprehensive basis, because you don't slow growth and development down as much by limiting emission of other greenhouse gases like methane and nitrogen oxides.

**TR:** But isn't carbon dioxide the greenhouse gas that we have the greatest ability to limit?

**SUNUNU:** It's also the gas that



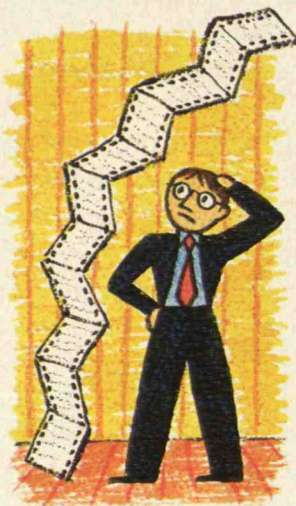
Mother Nature puts out in the greatest amounts—in quantities 30 to 40 times as large as what humans produce. I'm not saying not to include carbon dioxide in the mix. We ought to take a comprehensive approach. I cannot see the logic of those who say, we'll just look at one gas and not the others. One suspects when you hear that kind of illogical dismissal of the comprehensive approach that there's a slightly different agenda just below the surface.

**TR:** You're saying you favor reductions of all greenhouse gases, yet you've also been outspoken in your skepticism about the danger of global warming happening at all. If you're so unconcerned, why limit anything?

**SUNUNU:** I'm skeptical of the magnitude of the effect, because the computer models that have been used to make climate predictions are pretty incomplete—most ignore the thermal capacity of the oceans, for example. The environmentalists don't like to talk about the fact that the thermal capacity of the top meter or so of the oceans is as large as the thermal capacity of the entire atmosphere. I'm also a little reluctant to set multitrillion dollar international policies for the future using models that have been unable to predict the past—you know, given a starting point 20 or 30 years ago, to "predict" what has happened since then. The amazing thing is that the believers in global warming did a poll of scientists from their own mailing list. And only 13 percent said that there was any need to immediately put in place the kinds of policies they are advocating.

**TR:** So you think we ought to wait and see.

**SUNUNU:** When I was in the administration, I argued for a billion-dollar-plus research program, which the president strongly supported and which is now in place, to determine exactly what is going on and what is not going on and what the effects of a variety of scenarios will be. Yet there is this tremendous rush to have the world tie its hands *today*, instead of



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waiting for the results of that research to come through in the next few years. And there's no urgency. According to some studies, we have had virtually no warming over the past few decades. This idea that we have to tie our hands now, on the basis of bad data and bad models, when good data and good models will be available in a relatively short time, is part of what makes me urge people to look a little bit below the surface and examine what is really the agenda here.

**TR:** You call it tying our hands. One could also call it taking prudent safeguards.

**SUNUNU:** No. Prudent safeguards are what we are already providing, with the Clean Air Act and some of the energy efficiency policies in the proposed national energy strategy. We also have policies that deal with chlorofluorocarbons. But the environmentalists want to go beyond that. They are looking for permanent, binding commitments. I'm suggesting that this push to tie the hands of the world on carbon dioxide last June—that's exactly what it was, we had to do it *then*—would have been a rush to judgment before the facts are in. I might note that a recent report from the American Geophysical Union concluded that the effect of the eruption of Mount Pinatubo in the Philippines last year will significantly cool the earth for some time. At the very least, this delays by 20 years the day that the planet's temperature could rise to a dangerous level.

**TR:** So you think this volcano gives us some breathing room?

**SUNUNU:** Yes. And by the way, people had this information on the impact of the volcano for three or four months before the Earth Summit in Rio de Janeiro. The public announcement was deliberately delayed, in my opinion, until after they had a chance to do whatever mischief they wanted to do relative to the signing of the agreement.

It's all part of the small-is-better phenomenon. We saw that during the energy cri-



sis—environmentalists were the first to predict we'd be out of oil by the turn of the century. Yes, oil is a precious commodity that ought to be utilized efficiently and effectively. But we don't use that as an excuse to stop development and progress. And now, with global warming, we see the religious zeal to look only at the one greenhouse gas that's most related to economic growth.

**TR:** You approach these things with something of an ideology yourself—a pro-growth, environment-be-damned attitude.

**SUNUNU:** What I've argued for is analysis of both sides of the ledger: the benefits and the impacts. Policy decisions must be made by looking at both. And the entries into that ledger should be rational, not emotional. I suspect that part of the reason for the rush on global warming is that as the debate moves from the more emotional to the more rational analysis, environmentalists are recognizing that things are not going their way.

**TR:** If you were still in the White House, would you have recommended that President Bush go to the Earth Summit?

**SUNUNU:** I think the whole idea of the Rio conference was to corner the world leaders, particularly the president of the United States, in an election year, and to force them to make a decision that, on a more rational basis, they might not make. It should not be news to anybody that this is how the conference was designed. There were unabashed discussions along those lines by the people who put it together, plus a little bit of preconference gloating at how clever they were. Still, I think the agreement came out reasonably correct: it is a comprehensive approach, without specific targets. So it was really unimportant whether the president went or not, because he wasn't going to be cornered into doing anything beyond the agreement.

**TR:** In fact, critics say the agreement that has been worked out on carbon dioxide is worth-

less because it doesn't require any action.

**SUNUNU:** Which proves that somebody did the right thing. This rush to impose binding restrictions, in the absence of data, in the absence of analytic tools that justify making decisions of that magnitude, and in light of the fact that they all knew about the volcano's countervailing, cooling effect—suggests that there was no need to conclude that agreement right then and there.

**TR:** If it was such a rushed, unwise, unnecessary kind of constraint, why do you think the Europeans, the Japanese, and many others bought into it?

**SUNUNU:** They didn't. When you talk to most policymakers behind the scenes, you find out that they feel just as politically cornered as we do. It is a political box that they have been put in by people who have made it a hot issue. And that's the worst way to make policy.

**TR:** Since there is such a high level of uncertainty regarding predictions of global warming, and since the potential consequences are so disastrous, doesn't it make sense to hedge our bets and do something now, just in case?

**SUNUNU:** I'm suggesting that you eliminate the ignorance through research, by investing in improved computer models and analysis. This year, the United States is spending about \$1.3 billion for programs dealing with global warming impacts. We'd love many of the other countries of the world who are so militant on this issue to come even close to matching this level of research funding.

### Engineers in Government

**TR:** When have technical people influenced policy for the better?

**SUNUNU:** If you go back a little, you could say that the development of radar during World War II was a good example. Engineers suggested that technology could help the war



MOST OF  
THE  
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effort, and the idea was well received by those making policy. But I can't think of any recent successes. A lot of what we've done in the last decade or two has been dominated by emotional arguments with a large antitechnology swing to them, aided and abetted by a press that loves to play that tune.

**TR:** What kind of job do you think the media do in covering science and technology issues?

**SUNUNU:** On the whole, a pretty bad one. There are some rays of hope—occasionally, some constructive articles come out. But for the most part, articles have an apocalyptic tone that misses the mark in terms of science and technology.

**TR:** You seem to be suggesting a conspiracy.

**SUNUNU:** No, just broad disinformation, and misinformed, emotionally inclined decision making. Part of the problem is that there's a self-credentialing process that goes on. When people testify before Congress, for example, the real experts come in and testify on one side. And then, because there are not many credible folks who will come in and testify on the emotional side, you wind up with a self-selecting group of people willing to do just that. And they're willing to testify on almost anything—they keep showing up and become, by repetition, "experts."

**TR:** Doesn't business have a lot more money to spend on lobbyists than environmental groups do?

**SUNUNU:** Believe it or not, probably not for these issues. There's a lot of nonprofit money out there that is earmarked precisely for these issues, whereas it's awfully hard to get the private sector to do the same.

**TR:** Even though business has much more of a self-interest?

**SUNUNU:** Businesspeople don't see it as a self-interest—or at least they don't act as if it



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is. The auto industry, in particular, does a terrible job of dealing with these issues. They're so cowed by the other side's effective use of the media, in fact, that they're often afraid to get involved—and when they do, they do it badly. They're late in determining what their interests are, ineffective in analyzing what they ought to do and clumsy in practicing what they decide to do.

**TR:** Why do you think so few technologists end up in positions to influence policy?

**SUNUNU:** Most of the activities that are required to become influential in policy are counterproductive to an engineer's long-term professional interest. It's different in other professions. If you're a lawyer or even an insurance salesman, and you get involved in the process of influencing policy, it enhances your capacity to practice law or sell insurance.

**TR:** But it's not on an engineer's career ladder.

**SUNUNU:** Right. I've been involved in policymaking for 10 years. I can't go back to my consulting engineering business, or to being an engineering faculty member: I'm 10 years out of date. And so I have to practice with variations on a theme instead of doing the cutting-edge consulting work that I'd really enjoy.

**TR:** But you still think more engineers ought to get involved.

**SUNUNU:** I think a lot of problem-solving professions—engineers, economists—ought to be involved in both elected and appointed policymaking positions. I like to contrast them with professions that seem to find it easy to be there. We need more of the former and not as many of the latter.

**TR:** How would you make government more appealing to engineers?

**SUNUNU:** I don't know. I can only say that we need more people in engineering who care enough about the issues that they're willing to



make the real sacrifice to be part of the process. And there is a sacrifice involved. But it's fun, too. There's a tremendous gratification that comes from being an active participant and helping do things right.

**TR:** Isn't the public generally reluctant to trust technologists for answers to public policy questions? For example, nuclear power, which you strongly support, has turned out to be nowhere near as cheap or trouble-free as the engineers promised.

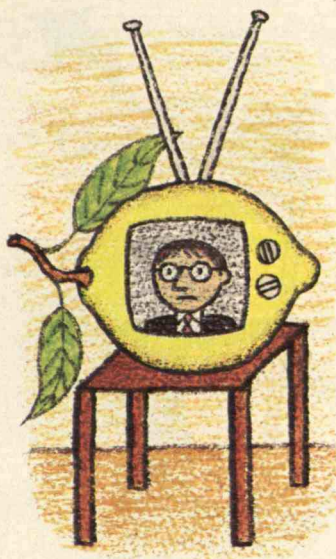
**SUNUNU:** But nowhere near as trouble-prone as the early days of fossil-fired steam power, when this country—and the world—had an amazing history of injuries and significant loss of life from explosions of boilers. But we didn't keep that from allowing the process to go forward, and I can't imagine anyone who would suggest that the world is not better off today as a result.

**TR:** Of course, nuclear power is different, because it has the potential—albeit very small—of spreading death and destruction much farther and passing its effects down through the generations. Even a small accident reminds people of that possibility.

**SUNUNU:** You're right. A small accident does remind people of that, and it certainly is the kind of thing that those who want to emotionalize the issue jump on and exploit. But look at Chernobyl, for instance. I think everyone recognizes Chernobyl was probably designed, built, and operated as badly as possible. I suspect that at some point somebody is going to do a hard analysis of that incident and conclude that we now have the upper limit on the damage that a nuclear reactor can cause. So in a way, as bad as that was, and as irresponsible as that was...

**TR:** It can be looked upon as a worst case?

**SUNUNU:** Right. And now the worst case is not in the imagination. We unfortunately have a real incident to look at.



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**TR:** How did you find your engineering training helpful as a policymaker?

**SUNUNU:** Aside from the quantitative intuition that comes with the profession, I also think I benefit from engineers' ability to break things down into their component parts, analyze them, and then put together a solution. In a way, that's how we built the Clean Air Act. I really believe that my background as an engineer was critical, not just in dealing with the technical issues, but in figuring out how to approach the problem in its entirety. Another important attribute, I think, is the capacity to recognize that you've got to define the problem clearly before you can start working on the solution. Too many people in politics talk about where they want to go, without ever knowing where they are starting from.

**TR:** For instance?

**SUNUNU:** Look at the oil crisis of the early 1970s. The world knew where it wanted to get to: it wanted not to be so dependent on oil, and the United States wanted not to be so dependent on imported oil. But world leaders never really understood the worldwide availability of oil and other energy sources. To this day, people don't have a good sense of how much coal, oil, and natural gas is available. And yet that's an essential part of laying out a reasonable energy policy. Many people are still reacting to the old legends that we're going to run out of fuel tomorrow. We *are* going to run out someday. But a scenario with dozens of years of available resources, or in some cases hundreds of years, is very different from one that has months. We go back to the global warming question. Knowing where we really are today is so important. We are not...

**TR:** On the brink?

**SUNUNU:** Right. And that's fundamentally my argument—that environmentalists are distorting where we are. We all probably want to get to the same point. But we are at a very different point from where they say we are.



## No Industrial Policy

**TR:** You have said that the best way to make the United States more competitive is to encourage more young people to become scientists and engineers. Do you think this encouragement should be left to the market, or should the government take charge?

**SUNUNU:** Hell, if you want it done right, don't let the government do it.

**TR:** But it's being left to the market now, and you seem to think something more is needed.

**SUNUNU:** The problem is that we have institutions hoping to create certain illusions of the present in order to get government assistance. We see all kinds of arguments—either engineer shortages, way off the charts, or engineer excesses, way off the charts. Now, I don't know if we're exceptionally short or exceptionally overproducing, but I know we're not both. In any case, though, it really doesn't matter. This country's private sector is not going to let itself be engineer short. Nor should it allow itself to have a glut of engineers, because then there's no incentive for the brightest people to enter the profession.

**TR:** But I presume you think that making the country more competitive is in the national interest. Doesn't that suggest a role for the government?

**SUNUNU:** It may be a matter of national interest, but it ought not be a matter of industrial policy. This country got to where it is without a national industrial policy. And it will only stay number one by not falling into the trap of introducing a national industrial policy. I don't want a bureaucrat in Washington deciding whether it's good or bad to have more engineers graduating 10 years from now.

**TR:** And you don't want a bureaucrat deciding that we should invest in fiber optics, say,



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INDUSTRIAL  
POLICY.**



instead of artificial intelligence?

**SUNUNU:** I don't want a bureaucrat, as was proposed three years ago, trying to tell us which technology in high-definition television we ought to be investing in. At that time, their darling was based on an analog signal. Thank goodness we refused to invest in that one, because we later found out that the best technology was a U.S. alternative, one based on a digital system, that was not being touted by the bureaucrats then. And that alternative is now about to give the United States a significant edge in high-definition television. If we had let the bureaucrats make the decision, we would have completely missed the best solution.

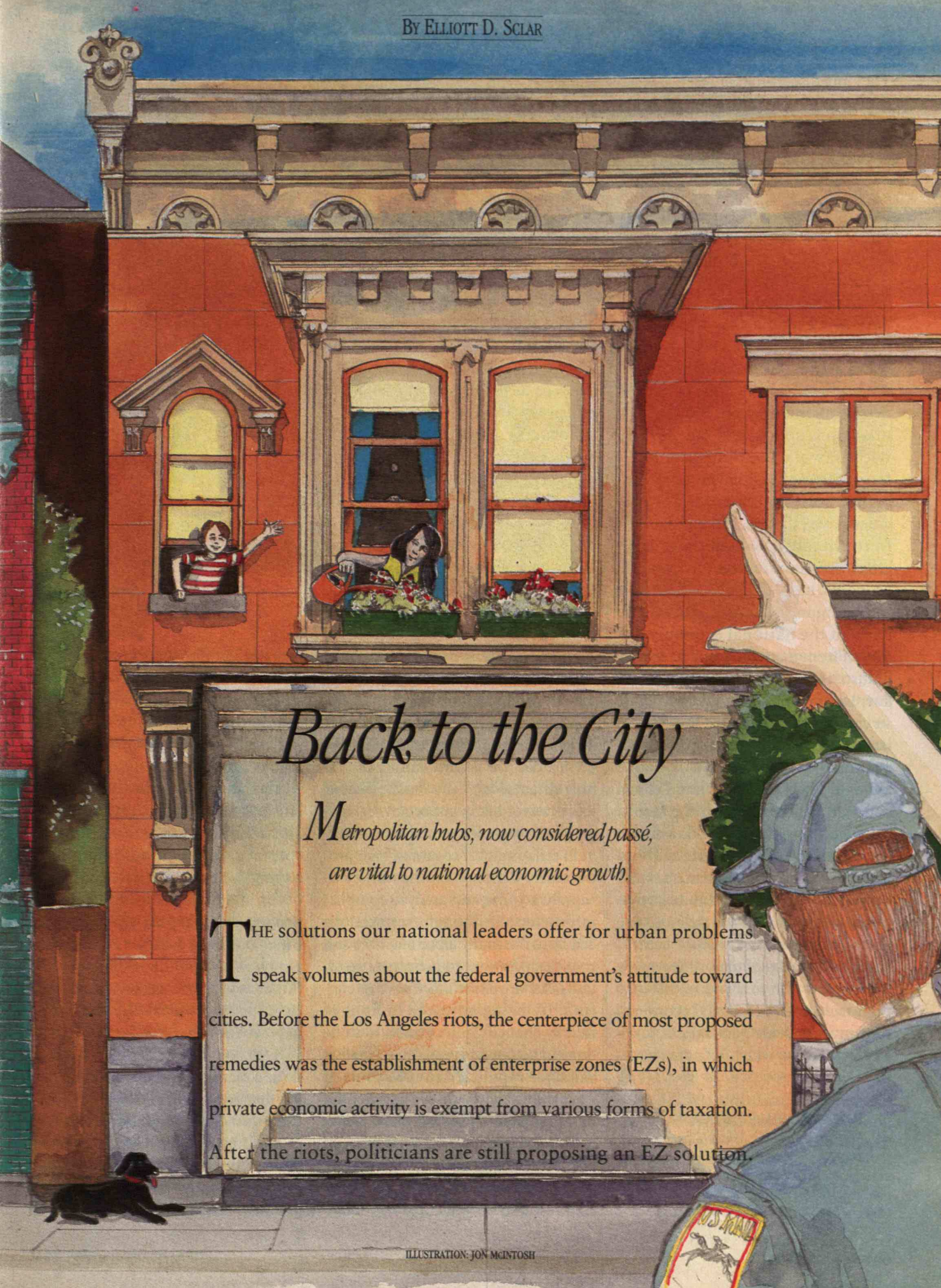
**TR:** What if industry seems to be lagging—not doing what it ought to do?

**SUNUNU:** There are enough good entrepreneurs out there who will make it unlag pretty quickly. This country still has the highest productivity in the world. That doesn't mean we sit on our hands, but we shouldn't change what got us here. And what got us here is not a national industrial policy.

**TR:** But with the end of the Cold War, the economy will be going through some huge changes. Doesn't the government need to get involved in the conversion process?

**SUNUNU:** It's a hard process. You have to be prudent on what you cut back, prudent in what you encourage to stay alive, in terms of both your defense needs and your domestic technology needs. It's a case of day-to-day adjustment. It's impossible to plan today what the real need will be five years from now. But whatever you cut, you let the private marketplace decide how to assimilate it. Conversion will be difficult, but it should not be an incentive to do something dumb, like establish a national industrial policy that in the long run would tie the hands of our greatest assets—the people in the private sector—and not let them be creative. ■





## *Back to the City*

*Metropolitan hubs, now considered passé,  
are vital to national economic growth.*

THE solutions our national leaders offer for urban problems speak volumes about the federal government's attitude toward cities. Before the Los Angeles riots, the centerpiece of most proposed remedies was the establishment of enterprise zones (EZs), in which private economic activity is exempt from various forms of taxation. After the riots, politicians are still proposing an EZ solution.



The only discernible difference is the decibel level with which the program is being touted.

Since there is no guarantee that businesses drawn to the zones will hire locally, EZs may or may not provide meaningful economic opportunity for the urban poor. But even if they do, programs designed to relieve poverty will not attack urban problems at their roots. Creating jobs will not unsnarl traffic jams, improve public schools, upgrade water mains, or put more cops on the beat—especially if the new businesses are undertaxed. For the root problem is not poverty but a steady withdrawal of public investment from cities. Under the national urban policy of the past decade, cities have fallen victim to a *laissez-faire* climate in which they are in effect deemed irrelevant to national economic health.

The argument runs as follows: The basis of the national economy has shifted from manufacturing to service industries. Such industries can locate anyplace that provides efficient public services. Therefore let the impersonal but efficient forces of the market determine which locations will thrive and which will stagnate. From a national point of view, whether a firm conducts its business from downtown Cleveland or the outskirts of San Diego matters not at all. What matters is that the firm can profitably produce its output at the least cost to itself and the nation's taxpayers. If older "central cities"—the hubs of major metropolitan areas—wish to thrive in this new high-tech, entrepreneurial economy, they must provide packages of taxes and services (of which EZs are simply

the latest incarnation) that meet the needs of industry. Some communities will undoubtedly win and others lose, but that is the nature of a vigorous market economy. It is not the federal government's job to prop up places that the market renders obsolete.

Such analysis never explains what happens to the communities that lose in the process of spatial competition. It is one thing for a firm to go bankrupt and have its remaining assets dispersed. It is quite another to assume that *places* can dissolve. As the recent LA debacle reminds us, the failure to pay attention to cities can literally blow up in our faces. One way or another, the costs of these centers' continued but impoverished existence are borne by society. If we let them deteriorate further, the added capital and operating costs of transferring their functions to the lower-density suburbs will overburden an already faltering national economy.

In fact, our nation's economic strength is nothing more than the sum of the economic strength of its metropolitan regions. Over half the U.S. population lives in just the 34 largest metropolitan areas. Within these areas, the geographically central hub cities occupy the most efficient locations for many important regional jobs, housing, and cultural activities.

In today's global economy, high productivity depends on the ability to rapidly acquire and analyze complex information. Although corporations can farm out many labor-intensive and routine operations to peripheral areas, tasks that are either innovative or continually being adjusted in light of rapidly changing information must be done in places where many specialists can have rapid face-to-face contact. That means they need the high density of the center city. Proximity is so useful, in fact, that producer-services firms—in law, accounting, advertising, finance, insurance, consulting, and other professions—often outbid corporate head-

quarters for office space in center cities.

Consider Citicorp, the nation's largest banking company. Citicorp can do the routine work of managing credit card accounts anyplace that promises low costs and a stable work environment. Indeed, its Visa and MasterCard operations are in Sioux Falls, South Dakota. But the corporation's important long-term strategic investment decisions must occur in a face-to-face milieu comprising counterpart executives at other banking firms, as well as an array of independent experts. For this reason, Citicorp invests heavily to maintain its world headquarters in New York City.

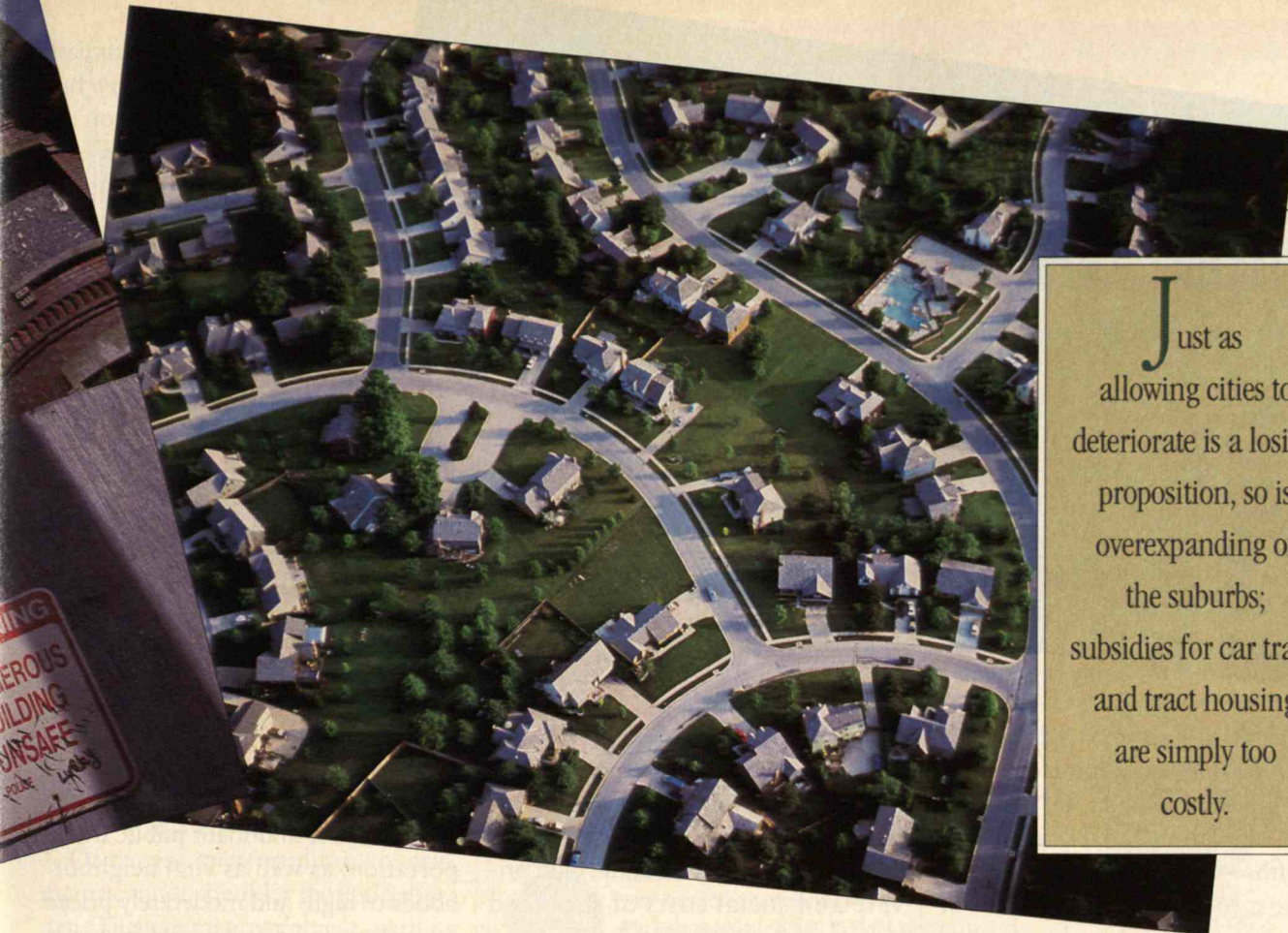
If we continue to insist, as we now do as a matter of *de facto* national policy, that great cities like New York run their vast locational assets into the ground, firms such as Citicorp, with its \$235 billion in assets, will eventually be forced to move their command and planning functions to peripheral and



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ELLIOTT D. SCLAR, a professor of urban planning at Columbia University, recently coauthored *Does America Need Cities?*—a monograph for the U.S. Conference of Mayors, published by the Economic Policy Institute in Washington, D.C..





Just as allowing cities to deteriorate is a losing proposition, so is overexpanding of the suburbs; subsidies for car travel and tract housing are simply too costly.

hence second-best locations. The cost to U.S. competitiveness and social well-being will be enormous.

### The Suburban Burden

Just as allowing center cities to deteriorate is a losing proposition, so too is overexpansion of the suburbs. Over the last century, every advanced industrial country has experienced some movement of its urban population into the surrounding countryside. This suburbanization has had several benefits: it has expanded people's choices of housing and lifestyle, relieved urban crowding and congestion, and given industry a broader range of locations in its search for efficiency and profits.

But suburbanization also imposes heavy costs. In the United States—the country where it has gone the farthest—suburbanization is underwritten by two massive subsidy programs: one for automobile travel (at the

expense of mass transit) and one for the establishment of tract upon tract of free-standing single-family homes (at the expense of higher-density multi-family housing).

The automobile subsidy takes many forms. These include the federally supported Interstate Highway System; the routine use of general state and local revenues to maintain roads, enforce traffic laws, and remove snow; land-use laws that require property developers to include parking; and unlimited federal tax deductions for employer-paid automobile expenses.

Single-family homes—the basic building blocks of suburban living—are subsidized mainly through deductions of mortgage interest and property taxes from federal income taxes. But federal mortgage guarantee programs are a form of subsidy as well. For example, programs available through the Federal Housing Administration and the Veterans Administration since the 1930s have permitted

people to buy homes even with small down payments. Until very recently, the procedures that screened properties for these programs were designed to discriminate against older urban areas. Although condominium-style multi-family housing is now eligible for similar treatment, such homes were not on the menu of options during the heyday of suburbanization in the 1950s and 1960s. In any case, condominiums still represent only a small fraction of the total housing stock in urban areas.

As a result of public subsidies past and present, American developers and consumers never faced the true costs of the sprawl they were creating when they made the important land-use decisions that resulted in mass suburbia. Those costs are astronomical. Environmental consultant Brian Ketchum recently estimated the total—including direct out-of-pocket expenses to travelers, indirect public costs such as road maintenance, and “external” costs such as pollution and time lost sitting





The rapid  
face-to-face contact  
that corporate  
executives need  
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only in the  
high density  
of the city.

in congestion—at over \$1.4 trillion per year. That's about a quarter of our gross domestic product. Of the \$400 billion or so in external costs, about two-fifths—\$168 billion—stems from time lost to congestion alone. One recent congressional study estimates that by the beginning of the next century, congestion costs will rise to almost \$400 billion per year.

Tax competition among suburban municipalities causes still other problems. As the costs of local services have outstripped growth in local property valuations, suburban governments have attempted to lure businesses from other towns, thus bringing in more revenue while trying to deter an influx of residents that would require new municipal spending. Besides inducing business activity to sprawl out even farther—creating costly traffic congestion in and between suburbs—these policies tend to concentrate the poor in the central city and older suburbs. Zoning that requires large lots and restricts multifamily housing makes it virtually impossible for the less affluent to follow jobs around the region.

In the first three decades after World War II, when U.S. labor productivity significantly outstripped that of the rest of the world, inefficient suburbaniza-

tion was not a problem. We could afford the higher costs of a low-density lifestyle and even justify it as a consumer good. But now that the productivity gap has narrowed, the high private and social costs of sprawled metropolitan living are becoming a major drag on our international competitiveness. We can no longer pay competitive real wages in the new world economy and still support living arrangements that are significantly more expensive than those of our more urban Asian and European rivals. If we try to sustain the high environmental, energy, and travel-time costs required, we must do so either at a lower standard of living for everyone or at the exclusion of still larger segments of the population from the present middle-class standard of living. Neither option is socially appealing or sustainable in a progressive democracy.

### Making Cities Livable

It is now time for us to reorder our thinking about the relationships between central cities and suburbs and the relative value of both. National “urban policy” needs to recognize the importance of central cities to the well-being of metropolitan

regions, and must in turn view those regions as the basis of our national prosperity.

Cities offer abundant public transportation, as well as vital neighborhoods of high- and moderately priced owner-occupied and rental housing. Cities also remain the repositories of culture and entertainment that can make life rich and fulfilling. With some public investment, they could provide large numbers of people from many walks of life with comparatively high living standards. Refurbished cities could sustain both the large moderate-wage labor force we will need to remain economically competitive and the high-wage professional work force needed to provide leadership.

The place to start the refurbishing effort is in urban neighborhoods. During the last several decades, urban development action grants, public-private partnerships, and old-fashioned real estate speculation have gone a long way toward renovating downtown office districts. Yet commuting over and around the ravaged neighborhoods en route is so obnoxious that people have gradually brought their businesses to the suburban areas in which they live.

Urban neighborhoods used to be



Such a policy is not meant to wipe out suburbia. After all, urban living—even at its best—is not everyone’s idea of the American Dream. I merely propose that we make cities once more a comfortable home for the middle and working classes who have lately fled to the suburbs to escape urban decay. Just as a shrewd investor diversifies a portfolio to ensure that it is balanced against all eventualities, we need the balance of vital cities as a counterpoint to vital suburbs. ■



# *The Simple Science*



PULL UP A CHAIR  
AND CONSIDER  
WHAT MAKES  
EFFECTIVE SEATING  
IN PUBLIC SPACES.



# of Seating

BY STEPHEN DAVIES



PHOTOGRAPHS: PROJECT FOR PUBLIC SPACES

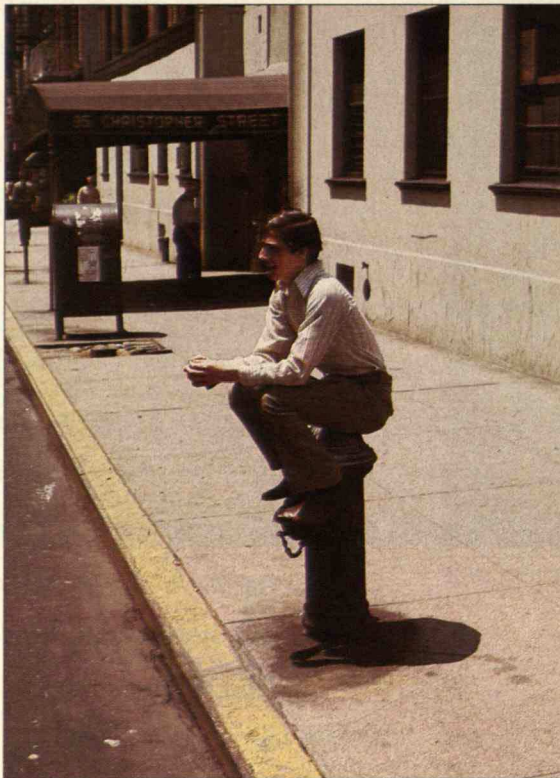
**I**F a city or town is to attract and serve people—in a word, to be “enjoyable”—it needs enjoyable places to sit. Pioneers like William H. Whyte, the noted author and observer of the urban environment, have long studied why some seating arrangements and other public spaces work splendidly while others totally fail. Armed with techniques such as surveys and time-lapse photography, these researchers have created a science of public space: principles that can be used to make communities more livable.

The key to effective seating, of course, is providing seats. But people will create their own arrangements when architects sacrifice comfort and convenience for design considerations, city governments don't realize the importance of seating or are afraid it will be used by “undesirables,” or developers neglect to provide seating





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*because they are trying to cram in as many square feet of building as possible. (1,2)*

*Almost anywhere that people can watch other people—where they wait for acquaintances or transportation, for example—is a good spot for seating. While planners often assume that people want to “get away from it all,” the truth is that most people want to be in the center of the action (and they won’t walk more than a few steps to get there). (3)*

STEPHEN DAVIES is vice-president of Project for Public Spaces, a nonprofit organization in New York City.





3

*Thus seating should be just out of the way of pedestrian traffic but with a direct view of it, unlike in this photo(4). If views compete—a pleasant waterfront and an active walkway, say—seats should be two-sided or backless, so that people can choose which way they want to face.*

*Arrangements should not force strangers to stare at one another: making eye contact is more threatening than simply sitting next to a person you don't know. (5, 6)*



4



5



6





7



8

*Sitting by a stranger can sometimes imply risk—beware of someone who sits next to you when there is an adjacent empty bench! Thus when few people are in the area, one bench per person or group is considered full. But when a space becomes crowded, strangers acceptably share a bench by adopting defensive postures. Crossed arms and eyes focused straight ahead are typical, even if a sitter nods off. (7)*

*Choosing the right designs for seats depends on the situation. If people need to rest for only a few*





9

moments, such as on a busy shopping street, backless seats with a hard surface encourage them to move on after a brief stop. A wooden bench with a back encourages people to stay longer. (8)

Since benches in long rows make talking and socializing difficult for groups, planners have come up with a great innovation: the movable chair. (Seats can be secured with chains and locks at night to prevent theft.) Chairs that people can move allow them to sit alone or in a group, even face to face. (9)

The effective range of materials and dimensions for benches and chairs is surprisingly narrow. Wood is the best surface because it is relatively resilient and doesn't get very cold or hot. The easiest seat to rest on has a height of 18 inches, while a seat-back of 20 inches is needed to support most people's shoulders. A curved front edge is better than one that is squared off. And bench slats 2 inches wide are most comfortable, although 8-inch slats, because they are hard to break, are preferable if vandalism is a concern.

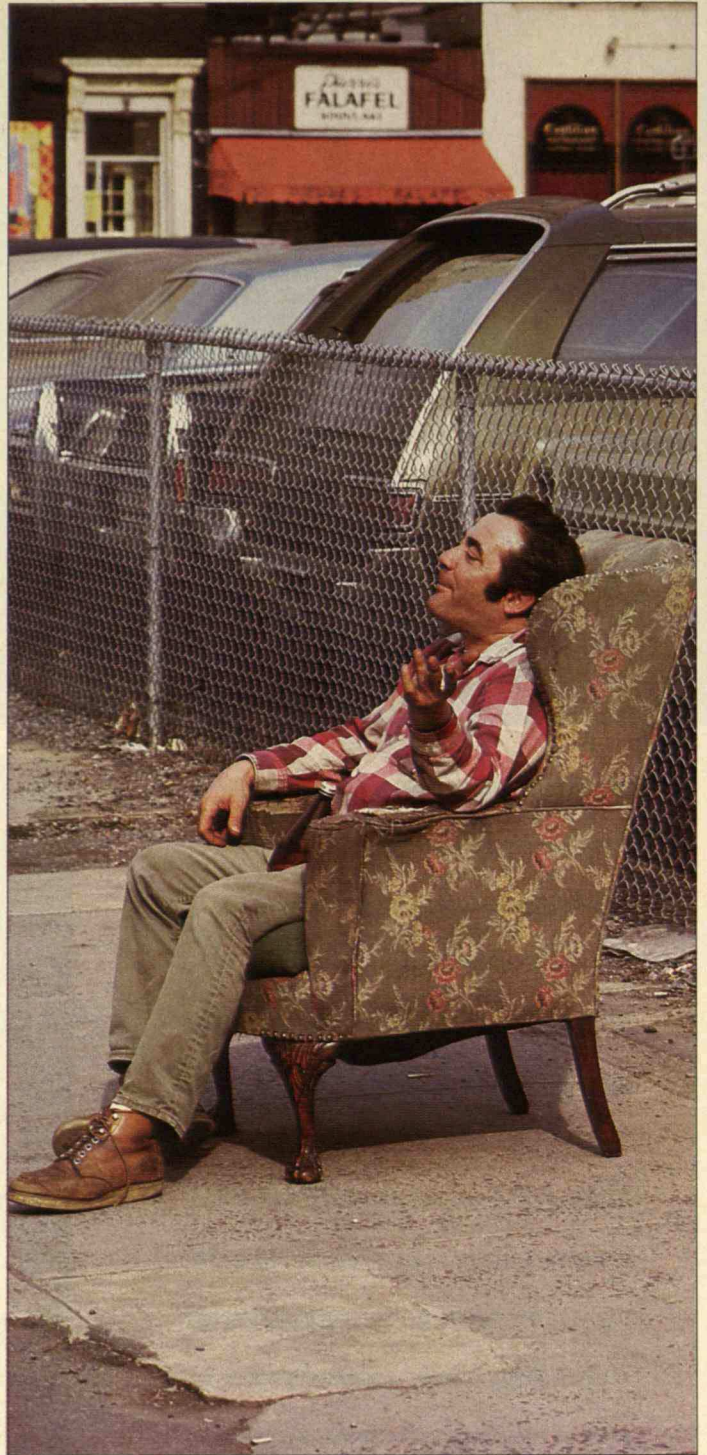




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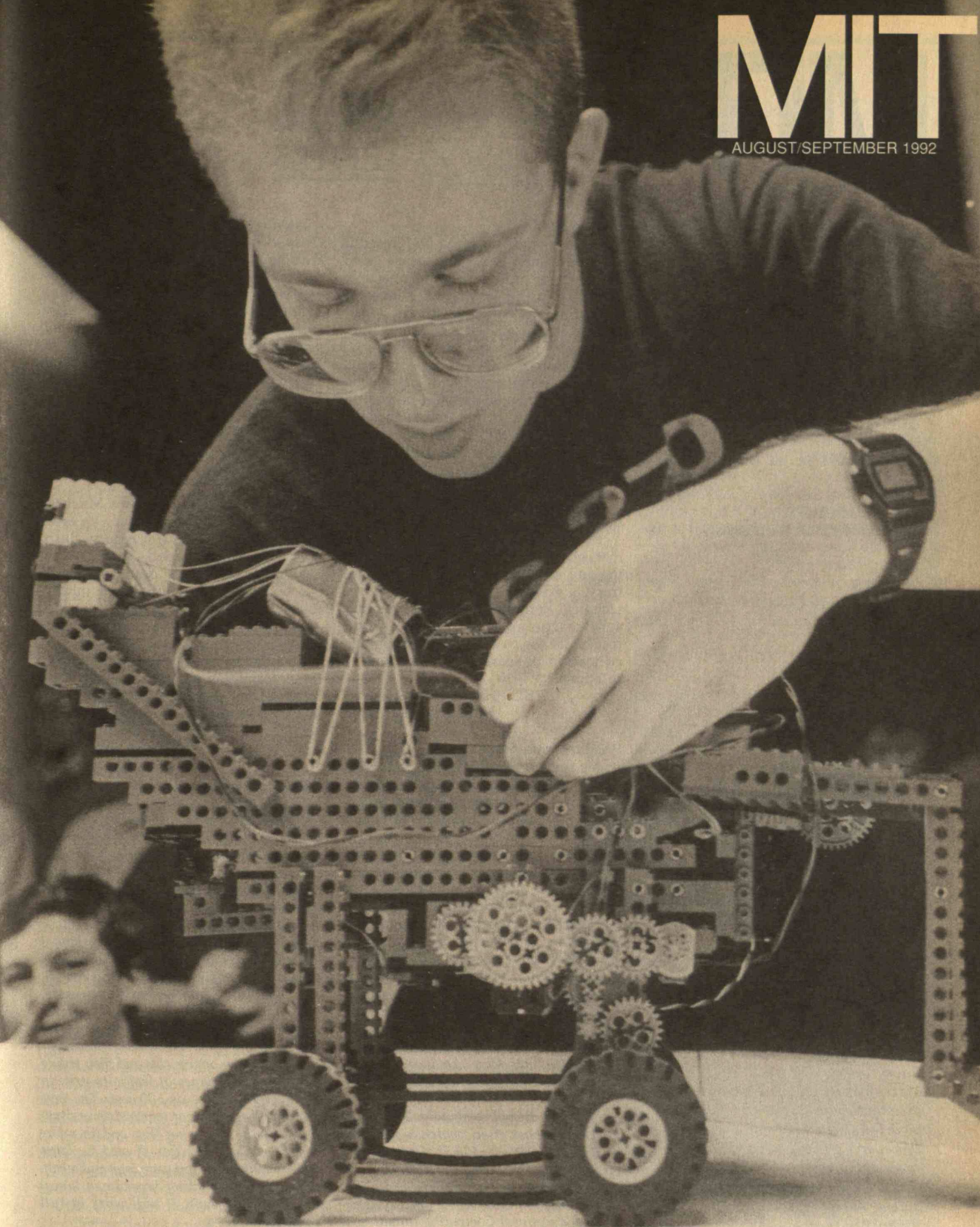
*Seating consists of more than benches and chairs, however. Steps and stoops can be great places to sit just above the action and people-watch. A grass lawn can be the ultimate in comfort in parks. And a simple ledge is a good way to provide seating or even a table—with the added benefit that a ledge doesn't look empty when it is not being used. (10)*

*What's the best way to design seating? Whether you're an architect, developer, or planner, you can't just sit in your office and come up with the best designs. You have to go outside and observe people's activities. Indeed, everyone can make this contribution and lobby for good seating. And if that doesn't work, remember that you can always bring your own. (11)*



11





*LEGO Unleashed: the 6.270 Contest*  
... page MIT 4





## LETTERS

### UNDER THE DOMES

Supporting Public Service  
Auctioning Lost Loot  
6.270—RoboCup, the Sequel  
The Ultimate Brass Ring  
1992 Edgerton Award

### COMMENCEMENT 1992

### ADDRESSING SEXUAL HARASSMENT

### DONALD SCHÖN, PHILOSOPHER BY DESIGN

### CLASSES

Darryl Robinson, '86,  
Black Entrepreneur

### COURSES

### DECEASED LIST

### PUZZLE



**Cover:**  
Matt Domsch, '94, a 6.270 course assistant, demonstrates a robot modeled after a dinosaur. Although this computer-controlled LEGO robot didn't compete in the 6.270 contest, it was a hit, especially among younger observers.  
Photo: Ben Wen

3

### Sold on Selling

I was pleasantly surprised and found it very refreshing to see the article "Zen and the Art of Selling" by Robert M. Metcalfe in the May/June issue of a journal such as *Technology Review*.

Metcalfe's four states of selling consciousness match my own experience since I started to build my company, Cityage, several years ago. I also echo his view that selling should be part of the curriculum. If that had been done while I was at MIT, time, effort, and resources might have been better spent, not only for the company, but also for our clientele. [Cityage provides real estate services in property development, investment, and management.]

Many people have the impression that selling involves a lot of smooth talking and no real substance. On the contrary, a good selling exercise requires technical knowledge of the goods and services being sold, empathy and respect for the customer, and continuing education in search of more creative solutions.

STEPHEN CHUNG, SM '86  
Scarborough, Ontario

18

### Wisdom from Athena

In his review of *MIT Project Athena, A Model for Distributed Campus Computing* by George Champine (TR, April 1992), Robert M. Metcalfe mentions Athena's use as an instructional system and then drops this important subject. Are there no lessons learned as to whether and how Project Athena contributes to the process of engineering education?

Has the instructional/learning activity been made better for the faculty and the 10,000 active users of Athena? If so, in what way(s), by how much, and what are the matrices of improvement?

ROBERT M. COPSEY, '44  
Hidden Hills, Calif.

47

Author Metcalfe offers two suggestions for Mr. Copsey and others interested in learning more about Project Athena's contributions to educational computing. The first is to read the book itself, which is available from Digital Press for \$28.95. Orders can be placed by calling 1-800-344-4825 and asking for Part No. EYH875E-DP.

Secondly, on December 7, the MIT Center for Educational Computing Initiatives is

sponsoring a symposium entitled "Education Computing in the Twenty-First Century: Building from Project Athena." The conference is designed for members of the academic and industrial community who are concerned with the effects of emerging technology on future strategies for education and industry. The morning session will focus on "Lessons Learned from Project Athena" and the afternoon will be devoted to discussing "Where the Lessons Lead." For information, contact the MIT Conference Services Office, Room 7-111, Cambridge, MA 02139; Telephone (617)253-1703; Fax (617)253-7002; e-mail trishs@eagle.mit.edu.—Ed.

### Central Artery to Expand How Much?

I enjoyed the May/June article on Fred Salvucci and the Central Artery. But I was surprised to read that "I-93's capacity will be almost doubled." There is a widespread opinion, borne out by the drawings in the article, that the artery will go from three lanes to four, hardly a doubling.

If, in fact, the capacity is doubling, this information should be widely distributed, and the project will pick up a lot of supporters.

ROBERT F. DANNER, '47  
Wellesley Hills, Mass.

The capacity of the Central Artery will indeed be more than doubled when work is completed. According to Fred Salvucci, key bottlenecks determine capacity, and in the case at hand, the worst bottleneck is the Charles River crossing, currently six lanes wide. The current preferred plan there calls for 14 lanes (some under the river).

The drawings by David Macauley that accompanied the article, showing how a section of road could continue to carry traffic during construction of the new Artery, were simplified for illustrative purposes. The breakdown lanes were not included, for instance. One of the chief problems with the old Artery is the substandard "weaving" of cars entering on one side and then trying to cross several lanes of traffic to exit, in as short a distance as 600 feet. The new design will eliminate or improve those situations, vastly increasing flow and therefore capacity. Where a section of road six lanes wide functioned as if it were four and a half, at 10 lanes (including breakdown lanes) with proper weave, it will work at full capacity.—Ed.





## Fellowship Helps Student Help the Community

A new fellowship program initiated by MIT's two-year-old Public Service Center (PSC) enabled Hartley Kuhn, '94, to exercise her passion for environmental policy in the gritty arena of Boston city planning. Supported by a \$1,200 PSC fellowship, Kuhn helped The Boston Harbor Association (TBHA) develop a position on plans for a federal courthouse to be built on Fan Pier in South Boston.

TBHA is a non-profit organization promoting a clean and accessible harbor, and includes representatives from business, neighborhood action committees, environmental groups, and government agencies.

Kuhn's \$1,200 fellowship was one of 19 grants the PSC awarded during the 1991-92 academic year under a program supported by the Lord Foundation and the MIT Employees Federal Credit Union. The fellowships enable students to meet their bills—and the self-help requirements of their financial aid packages—while taking on valuable, non-paying projects with community agencies.

Kuhn, a sophomore in urban studies and planning, had the track record to back up her avowed interest in the environment. Last summer, she served as an intern in the office of Rep. Nicholas Mavroules (D-Mass.), where she drafted a memo encouraging the congressman to sign on to House Resolution 96, which would mandate recycling for the House of Representatives. At MIT, she helped initiate a recycling program at Baker House, and she has worked for the student organization Share A Vital Earth.

She spent this year's Independent Activities Period researching the federal courthouse project. Her assignment was to consider the impact of the courthouse on the environment and on access to the harbor, to develop a position for TBHA to take when advising the government sponsor and the architects, and to present her findings to TBHA Board of Trustees.

She concluded that the courthouse's environmental impact would be negligible. Traffic congestion will be minimized by the construction of a new Northern Av-

enue bridge and the extension of the mass transit system, parking will be provided in an indoor garage, and air and noise pollution will only be a problem during construction, Kuhn wrote in her summary.

She was concerned, however, that the development might discourage public use of Fan Pier, which "affords the grandest view over Boston and the Harbor." To ensure that the development is both accessible and inviting, Kuhn suggested that the Harborwalk, "a broad, well-lighted, tree-lined boulevard" along Foster's Wharf and Rowes' Wharf, be extended to Fan Pier. She also suggested that a Harborpark be part of the development and emphasized that the courthouse must be designed to minimize the effects of winds and shadows at street level.

In January, Kuhn's presentation to three members of TBHA and its executive director, Vivien Li, '77, drew a very positive reception. "She did a phenomenal job," says Li. "We'll use her memo as the basis for much of our discussion."

The internship was equally rewarding for Kuhn, enabling her to meet professionals in architecture, urban planning and design, and environmental policy, and even providing some career direction. "I had intended to study the environmental impacts," says Kuhn, "but my internship ended up focusing more on the planning aspects of development." She is considering a greater concentration on planning in her future studies and continued to work for TBHA in her free time during the spring term.

While the Public Service Center emphasizes the service aspect of the internship program, Vivian Li believes that the experience should be valuable for the intern as well as the employer. "At TBHA we provide very meaningful, substantive experience and try to help the interns advance in their careers. They get excellent work experience, and we get a great product." □

—MARGARET DOYLE, '92 (The author completed a degree in mathematics and plans to pursue a career in science journalism.)

**When Anne-Imelda Radice, acting chair of the National Endowment for the Arts, denied a grant application for an exhibit entitled "Corporal Politics" at MIT's List Visual Arts Center, she was overturning favorable decisions of both an NEA-appointed peer panel of arts experts and the presidentially appointed National Council on the Arts. In the process, she ignited a national firestorm of protests. But the Boston rock group Aerosmith showed up on campus with a check for \$10,000, to ensure that the exhibit—which includes sexual and bodily imagery—would go on. Band members Tom Hamilton, Joe Perry, and Steve Tyler presented the check to Helaine Posner, List curator.**





## 6.270—RoboCup, the Sequel!

**T**he Sixth Annual 6.270 LEGO Robot Design Competition, held in the spring semester, did double duty as a final exam of sorts for the 150 students enrolled in a month-long, accredited Independent Activities Period course.

Divided into teams of three, the students designed, constructed, and programmed robots using LEGO parts, Polaroid motors, electronic sensors, and a custom microprocessor board. The game plan for this year's contest was to have each robot collect ping pong balls from a dispenser and deposit them into goals at either end of a table. By tapping the dispenser's "touch bumper," a robot could acquire one ping pong ball every five seconds.

While it may look a lot like the classic 2.70 Introduction to Design Contest, the tip-off is the absence of remote controls. All the 6.270 entries were completely preprogrammed to perform their tasks; once the competition started, the students could not manipulate or otherwise interfere with their machines.

The robot contest was developed by Pankaj Oberoi, '91, a graduate student in Course VI; Randy Sargent, '89, a Media Lab research specialist; and Fred Martin, '86, a PhD candidate at the Media Lab. According to Oberoi, "Students learn everything from mechanical engineering to electrical engineering to computer architecture" while participating in the contest.

Martin, whose dissertation deals with the development and analysis of the 6.270 project and who was featured in a *Newsweek* article on robots, is protective of the word "robotic." "Everyone tosses it around, but few define it properly," he says. "A robot is a sensor-controlled machine. Machines that are remote-controlled are not robots."

Martin wants to see 6.270 continue, he says, but not in the same direction. "There was so much complexity in this year's playing field—it took a lot of building and maintaining. I would like to see a more passive robotic environment in the future." The devices to release balls didn't work consistently; requiring the robots to locate the goals and other machines by detecting an infrared light



*Ken Duda, '92, (left) and Ken Tobin, '92, put some finishing touches to Rolling Rudderhead. Although they weren't finalists, their team attracted a lot of attention, as much for Tobin's headgear as engineering wizardry.*

source monopolized too much design time; and having two methods of scoring a goal made scoring a nightmare. In fact, Martin blames the complexity for the fact that this competition had little of the clever attack strategies between machines that makes the 2.70 competition so exciting. "When it takes all you have to move the machine, you are less likely to play offensively," he observed.—*Sherrie Saint John* □

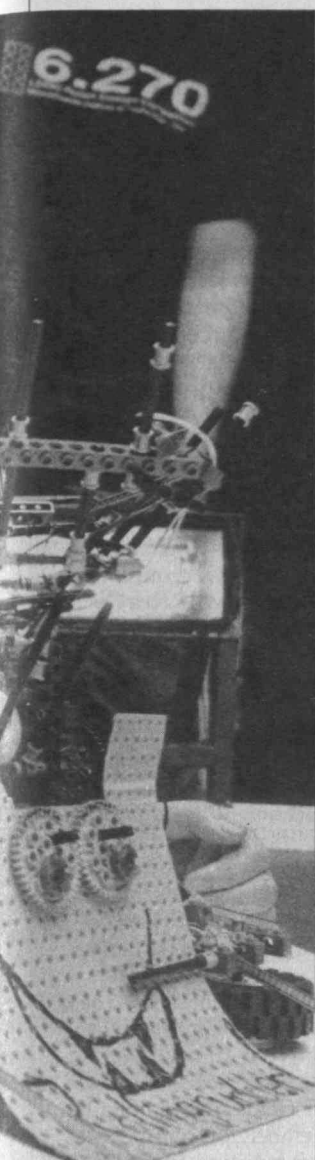
## We Knew It All Along

**I**n its 1992 report on graduate programs in engineering at U.S. universities, *U.S. News & World Report* put MIT at the top of the chart, with the premier programs in 7 of the 12 engineering disciplines they considered. The publication conducted two surveys on academic quality, asking engineering deans and

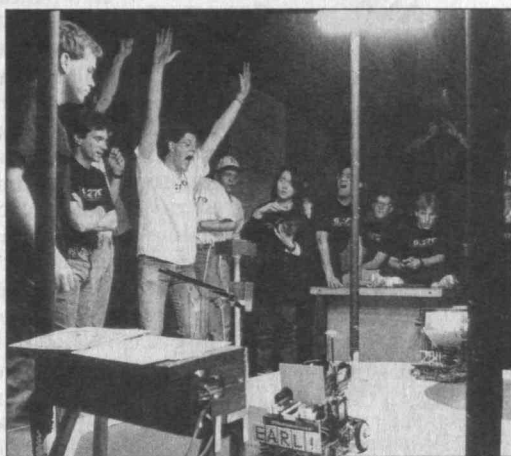
deans of academic affairs to rank each school and also asking 785 practicing engineers to select the top 15 schools nationwide. *U.S. News* staff also gathered data on quality indicators such as research volume, number of PhDs granted, ratio of graduate students to faculty, percentage of faculty holding doctoral degrees, percentage of applicants accepted, and percentage of those offered places who decided to attend.

While MIT and Stanford shared first place in the academic rankings by their university colleagues, MIT was way ahead in the ranking by engineers—first place as compared with Stanford's fifth place. In speciality rankings by engineering deans, MIT's programs in aerospace, chemical, computer, electrical/electronic, materials, mechanical, and nuclear engineering were considered the best in the country. MIT was ranked fourth in





The contest winners (left to right), Marcus Kramer, '95, Chris Ward, '95, and Sumer Johal, '95, posing with their entry Dizzy Devil. This is the third year in a row that a freshman team walked away with the top prize, a king-size LEGO kit.



Enthusiastic students revel as Earl! wins another round. Semi-finalist Earl! was built by Stephen Chamberlin, '93, Lenny Granowetter, '93, and Matthew Olsen, '93.

biomedical engineering and third in civil. Ocean engineering was not listed.

U.S. News particularly cites MIT for a new program in environmental engineering education and research, for innovative courses to teach engineers how to deal with regulatory trends, and for the increases in students studying both management and engineering. □

## MIT Police Auction: Jewelry, Calculators, but No LISP Machine

**Q**uestion: What do a broken ski rack, an imitation diamond ring, and a handful of Hewlett-Packard calculators have in common? Answer: they were all items on the block at the second MIT

Campus Police auction held early in spring.

The doors opened at 12:05, revealing five tables of loot. There were gold rings, bracelets, digital watches, and calculators—even a slide rule. Most of the serious connoisseurs seemed disappointed with the pickings. "I'm looking for a modem—9600 baud—and possibly a LISP Machine," said Noah Friedman, a staff member of the Free Software Foundation. But the only two computers there were a five-year-old Macintosh Plus (with a single megabyte of RAM) and an antique 8080 Cromemco.

"I wouldn't pay more than \$20 for the Mac," said Phil Servita, a computer programmer from Medford. What he really wanted was one of the H-P calculators. There were 10 of them, shuffled in among a bunch of Casios, Radio Shacks, and Sharps. "I'm interested in one of the 15Cs. At a ham fest, it would go for \$10 or \$15," he estimat-

ed, referring to the swap sessions for electronic gear that are a regular feature in the amateur radio community. Servita was pretty sure an H-P 15C would go for a lot more at the MIT police auction. "After all," he said, "we're in a room full of nerds."

Make that a room half-full of nerds. The other half—mostly members of the MIT office staff—had come to look at the jewelry.

The auction started promptly at 1 p.m., with a row of bicycles, most with rusted chains, bent handlebars, and flat tires. The jewelry went on the block at 1:30.

One of rings looked genuine: a diamond in an antique gold setting accompanied by two sapphires. Tareq Hoque, '88, a graduate student at the Sloan School, bought it for \$85. "It's a gift for my girlfriend," said Hoque, who estimated its value at \$200. "It was definitely worth a lot more than I paid for it," he said later.

It was nearly 2:30 by the time the officers running the auction got around to the calculators. By then, only the diehard junk collectors were left. And the engineers.

The CPs had decided to hold the H-Ps for last, and the Radio Shack went for a dollar. Then another Radio Shack went for a dollar. Three Casio calculators, grouped, sold for five. Soon people noticed that one student was buying a lot of calculators. "I'm going to give one to my professor, put some of them in the lab, and hand out others at exams," said Kenneth Zemach, '91, a graduate student in mechanical engineering. For an investment of \$30, Zemach had acquired eight calculators.

By contrast, most of the H-Ps went for around \$20 each. The students who lost out on the bidding for the H-Ps went to "Mr. Calculator," a.k.a. Ken Zemach, and prevailed on him to sell part of his collection for \$5 to \$10 apiece.

When the Macintosh came on the block, most of the spectators groaned. Who could possibly want it? Two people did, it turned out, and the unit sold for \$125. The Cromemco was last to go. By then it was 4:30, and the officers didn't even bother collecting the 25-cent winning bid.

In total, the auction brought in \$2,864. Friedman didn't find a Lisp Machine, but he did walk away with an H-P 22S 1. It cost him \$41, however, after a bidding war with this reporter. □

—SIMSON GARFINKEL, '87 (The author is an editor at NextWorld magazine.)



# Was It a rat I saW?\*

While less than a quarter of college students nationwide buy a school ring, nearly 90 percent of those who leave MIT with a bachelor's degree do so. Like a fraternity handshake, it is a connection among alumni/ae. Many people outside the MIT community—executives in Japan, for example—can also identify the wearers of the Tech ring as members of a very exclusive club.

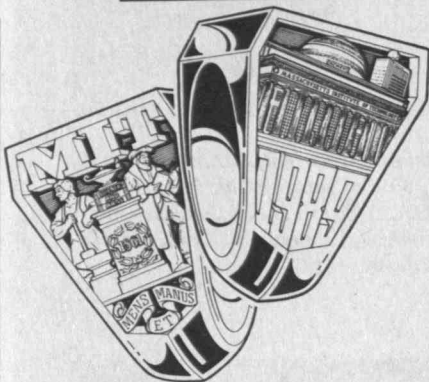
"I've had countless graduates tell me the ring has served as a mode of introduction, as well as a conversation piece," reports Paul Gray, '54, who recently completed his first year as chair of the MIT Corporation. "MIT is a time of testing," says Gray. "The ring becomes a symbol of that rite of passage."

It was not until 1929, 70 years after its founding, that MIT formed a committee to design a "Standard Technology Ring," with one member each from the classes of '30, '31, and '32. Theodore Riehl, '30, who chaired the committee, remembers that they decided early on that the ring would be distinguished from other collegiate symbols by having "no cheap stone" on the face. There was a lively debate about what would appear in place of a gem, with the Great Dome and the beaver, the Institute mascot, the top contenders. "With the realization that many schools had domes somewhat similar to Technology's," reported the 1930 *Technique*, "the Institute Committee decided to use the beaver. . . . The dome lent itself particularly well to use on the shanks (the sides of the ring)."

Riehl, as committee chair, received ring number one, which he later donated to the ring collection in the MIT Museum. Both shanks show the Great Dome of Building 10, with "MIT" etched below one dome, the class year "'30" beneath the other. Astride the crest is the beaver, looking rather gaunt compared to later incarnations, perhaps a reflection of the deepening Great Depression. Sometime in the decades to follow—MIT Museum Director Warren Seamans guesses rather early on—the ring became fixed in Institute consciousness as the "brass rat."

The Class of '63 ring committee was the first to depart from the basic design, and the

\*The headline is a palindrome used in advertisements for the 1990 class ring.



last 30 years have seen a series of unique class rings. The class year is often hidden in the ring: roman numerals embedded in the twigs the beaver nibbles, a number in the beaver's tail, or the tiny windows in the Great dome spelling out the year in binary code. And the Class of '93 ring, honoring one of the Institute's most beloved personalities—inventor of strobe photography "Doc" Edgerton, '27—shows an apple with a bullet heading toward it, a reminder of one of Doc's most famous pictures.

The '89 ring included an owl, symbol of MIT's campus-wide Athena computer network, and was distinguished by even more radical innovations, as brass rats go. It had a second beaver, swimming in the water behind the traditional animal. This "buddy beaver" was intended to represent all those who helped the graduate though the four years at MIT, but its tiny size rendered the symbolism rather

moot. And for the only time in the history of the ring, the beaver faced right. The sales brochure claimed the position was more accurate, since once graduates leave Cambridge, they gaze east to MIT. It was not a persuasive argument, and subsequent classes turned the beaver back to its standard orientation.

The Class of '90 introduced the skylines of MIT and Boston—complete with the famous Kenmore Square Citgo sign—on the front and back of their ring, and that new feature caught on. "Everyone wants the Citgo sign now," observes Robert Bickel, the national account manager for the Balfour ring company. The change is even accompanied by a new explanation of why graduates turn their rings around at graduation: while a student, one looks over at the Boston skyline; after graduation, distant alums look back on the buildings of Alma Mater.

Over the years, there have been disagreements among the ring committee members and their constituents that escalated into the parliamentary equivalent of warfare. To outsiders, a flap over beaver design might seem to be a lapse of common sense prompted by too many problem sets and all-nighters, too much Jolt cola and cheap beer. Warranted or not, the intense feelings are genuine. One ring committee member, for example, was so incensed about a design featuring a beaver gnawing on a tree trunk instead of twigs—a break in a 52-year tradition—that she resigned.

With the 1992 ring, the brass rat encountered politics. To acknowledge the fact that their graduation year was also the 500th anniversary of Columbus's arrival in the Americas, the committee included the "mens" (mind) figure from the MIT seal, clad in garb like that seen in portraits of Columbus. There was a protest from the MIT Native American Student Association, which like Native Americans elsewhere across the country, objects to the idea that Columbus "discovered" a continent where their ancestors had been living for thousands of years. After a hurried discussion between Balfour and the ring committee, the figure was outfitted with more traditional attire.

Paul Gray is somewhat saddened by the direction the brass rat has been taking. "I



find the drive to be unique for each class unfortunate. The rings are being changed just for the sake of being different, and it has led to controversy. There used to be more of a unifying symbolism to the ring. A student is part of MIT, not just a specific class."

Even without the occasional controversy, winning the MIT ring contract involves a significant effort and expense for companies like Balfour and Jostens, which both competed for the Class of '94 ring. They take the student committee on plant tours, as well as provide food and beverages for every meeting during the weeks of negotiation. For many years, committee members were even offered free rings.

Since design joined price and quality as key factors in the decision, ring company artists may make up to 50 renderings of the ring's three faces. This year, Jostens flew its top designer (the creator of the '84 and '88 Olympic medals) to Cambridge several times, and still lost out to Balfour in a controversial, close vote. "It's a crazy life and death situation," says Balfour's Robert Bickel. "Our fate is in the hands of 19-year-olds!"

In spite of the stress and (they claim) relatively low-profit margin associated with the brass rat, the ring companies are still eager to win the contract. "The ring is so unique," explains Terry Coughlin, Balfour's college ring product manager. "There's nothing more noticeable and recognizable in the industry." □—JOHN TRAVIS, '90 (The author is the northeast correspondent for Science magazine.)

## Changing the Way We "See" Film

Assistant Professor of Literature Henry Jenkins has been awarded the 1992 Edgerton Award, which honors a junior member of the faculty for outstanding teaching, research, and service to the MIT community. Jenkins is widely regarded as a founder of a new area of scholarship centered on the relationship between the narrative arts of the mass media and their audiences. He accords audiences a more active role in the creative process than have previous

researchers; for example, he has documented how *Star Trek* fans have appropriated the program materials to create their own underground literature surrounding the series.

The Edgerton Award Committee also noted that as the only full-time film scholar in the MIT literature faculty (he specializes in movie comedy in the early sound era), Jenkins "put film and media studies on the map for undergraduates."

"As we increasingly become a society organized around image control," the committee went on, his work on the "relationship between images and the communities that appropriate, re-edit, and personalize them will become increasingly important in sociological and political analyses. . . . He is one of the few well-trained humanist interpreters to enter this area and is helping establish MIT as a leader" in the field.

Author of two books and a dozen articles, Jenkins has been on the faculty for only three years. He came to MIT after completing a PhD in communications at the University of Wisconsin. □

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# Rained On, Not Rained Out

By Debra Cash

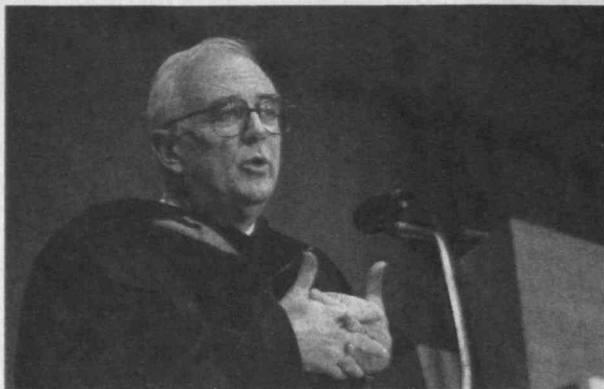
At 6:30 on the morning of Monday, June 1, Mary Morrissey looked at the sky and acknowledged that the rain was *not* going to stop. It was the moment she had dreaded, having called MIT meteorologist Michael Morgan three times a day since the previous Thursday, hoping that the storm predictions would prove wrong or be changed by some graduation-friendly winds.

Morrissey is the executive officer for commencement—her office is Graduation Central. Much as she hated to lose the outdoor venue that could accommodate all the graduates and their families and friends, she and her cohorts were ready. On Sunday she had alerted the Registrar's Office and the Physical Plant Department, which had been working for weeks to install the platform, ceremonial landscaping, 9,000 chairs, sound system, and security arrangements in Killian Court.

By commencement morning, it was obvious that for the first time in 13 years, MIT graduation exercises would move from the stadium-sized space of Killian to the protected confines of Rockwell Cage, and the thousands of guests would have to be diverted into three separate arenas: du Pont Gymnasium, Kresge Auditorium, and the ground floor of the Johnson Athletics Center.

PHOTOS: PAULA LERNER





*Rep. Les Aspin, chair of the House Armed Services Committee (top left), delivered the commencement address to the MIT class that is part of the "first graduating class of the post-Cold War, post-Soviet era." Some of those graduates may help develop the new, more sophisticated weapons-detecting systems that the United States will need to protect itself, Aspin said, in this era when the nuclear threat is from*

*maverick regimes or terrorist groups, rather than another superpower. President Charles Vest also had rather somber remarks, observing that this society is fragmenting "along almost every conceivable line." But when he got to the happy task of distributing undergraduate degrees in the Johnson Athletics Center (second from top left), there were nothing but smiles.*





There were exactly three and a half hours between Morrissey's decision and the scheduled processional. Everyone went into high gear. "Campus police, Registrar's Office, food service, carpenters, electricians, operations people, Institute staff, you name it. Everyone worked side by side," she said, "with no ranks, no barriers, everyone quietly pitching in together."

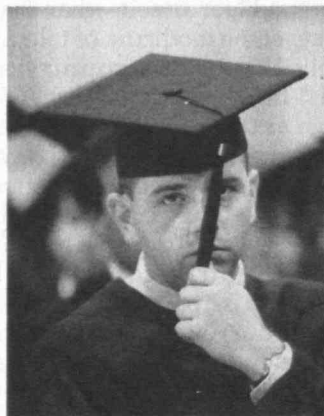
"What was most impressive was that they did it for the students and their families," Morrissey says, "because everyone wanted this important day to come out right." Remarkably, when the time came for the 1,705 graduates to march into Rockwell with the Class of '42, celebrating its 50th reunion, and the Class of '67, marking its 25th, things were running *ahead* of schedule.

Patience, commitment, and a certain sense of humor—President Charles Vest joked that he wasn't going to give out the bachelor of science degrees to those majoring in atmospheric science—carried graduates and their families, faculty, and staff through a day that was ultimately a joyful and memorable celebration.

President Vest charged the graduates to use their educations wisely and well. "I can think of no greater goal to ask you to set for yourselves—and I for *myself*—than that of restoring some modicum of tolerance and civility in this country and world," he said. "How strange it is that just as the world revolts against communism and moves toward democracy . . . we begin to fragment along almost every conceivable line in our society. . . . You must help us to stem the centrifugal forces that would pull us apart. We need tolerance, not divisiveness; mutual respect, not disdain; love, not hate; civility, not revenge; hard work, not







empty rhetoric; excellence, not mediocrity; grand strategies, not just tactics.

"We're counting on you," Vest said, a comment echoed by commencement speaker Les Aspin, PhD '66, the Wisconsin Democrat who holds a doctorate in economics from MIT and chairs the Armed Services Committee of the U.S. House of Representatives. Speaking to what he called "the first graduating class of the post-Cold War, post-Soviet era," Aspin described a changed environment in which not the Soviet superpower but a "third party—a country, a terrorist state, terrorist organizations" with ballistic nuclear weapons presented a "residual nuclear threat" to the United States.

Noting that "it makes no sense to spend many billions of dollars on an antiballistic missile system if we are going to leave ourselves vulnerable to other delivery vehicles," he dismissed the Reagan-sponsored Strategic Defense Initiative as an "impossible astrodome" and went on to say that instead, the United States needs to consider defenses against "air- and sea-borne threats and suitcase bombs. It means we have to increase our intelligence capabilities and it means we have to put more effort into our technology for the detection of nuclear weapons by customs officers and coastal defense."

Aspin called for the United States to sign a comprehensive test-ban treaty, pointing out that countries like China might be more likely to adhere to a ban if the U.S. halted its own tests.

After listening to these speeches, the graduates were led by faculty marshalls to the three sites where their families waited to see them receive their diplomas. It was there that the Crisis of the Colored Tickets surfaced. Since graduates are each entitled to four tickets for seats, it is

common for them to share their extra passes with friends. When graduation takes place in one central area, there's no problem. But people suddenly discovered that tickets for du Pont didn't necessarily admit them to Kresge. Nonetheless, once settled, many families found that the more intimate settings for the granting of diplomas was a plus, and (audible sigh of relief from the Registrar's Office) there was not a single reported case of a graduate not receiving the correct diploma.

What's in store for the class of 1992? Robert Weatherall, who directs the Office of Career Services and Pre-professional Advising, says that while he isn't sure how many graduates in the Rockwell Cage had jobs or graduate-school slots lined up as of June 1, MIT students do well even during recession years. "While employers have cut back on recruiting efforts overall, they still target the best students at the best schools," he explains.

What's different this year is that students are crossing disciplinary boundaries. Weatherall notes, for example, that the common thread among the geophysicists, civil engineers, and electrical engineers recruited by Schlumberger for its Austin, Tex., systems center is computer know-how. Even Wall Street firms are looking for MIT graduates who can apply sophisticated mathematical thinking to portfolio management.

Openings are scarce, however, for those graduates seeking academic appointments. But as Weatherall says, "MIT students have great strengths. Sitting in the Cage at graduation, they were sheltered from the rain, but they were also sheltered by their talents." □

*DEBRA CASH is a frequent contributor to Technology Review.*



# Confronting Sexual Harassment at MIT

## *A Progress Report*

By Kimberly French



*"At MIT we take harassment seriously."*

Those words appear on a bright-yellow pamphlet posted on the women's issues bulletin board in the infinite corridor. Next to them, someone has written, "Oh really?"

The two comments—one official and striving to put the Institute in the best light on this extraordinarily difficult issue, the other anonymous and critical—could be the short version of the discussion over how MIT handles sexual harassment. MIT has several firsts and bests to be proud of in this area, just as it is accustomed to citing in academic areas. At the same time, frustrated and angry critics—students, faculty, and employees—have raised serious concerns about the administration's handling of sexual-harassment complaints.

For several days in October 1991, the Institute community, like the rest of the

nation, watched the televised Clarence Thomas-Anita Hill hearings. Suddenly the term "sexual harassment," which not long ago hadn't even been coined, was everywhere—in newspaper columns, on television specials, and in conversations at work and at home. What is it? Have I done it, even unknowingly? Have I been a victim of it? How can men and women see things so differently?

The following week, MIT released its booklet, *Stopping Sexual Harassment: A Guide to Options and Resources at MIT*. The booklet was designed as a "road map" that would direct victims to the people who can explain the Institute definition of harassment, listen to grievances, and outline possible remedies. The timing was impressive, and people asked administrators how MIT was able to produce a publication so soon after the hearings. Actually, it was a lucky coincidence. In December 1989, Provost

John Deutch, '61, had appointed an MIT Committee on Sexual Harassment, chaired by Associate Provost Samuel J. Keyser. In October 1990, the committee issued its report recommending the guide, which took another year and more than one team of authors to write. The guide's publication date made the Institute look current, and, more important, it brought the national discussion to the campus at a time when people were ready to pay attention.

In fact, MIT has been much more than current on sexual harassment. MIT became the first major employer and the first university to use the term and to set policies and procedures for its prevention and complaint handling. This was in 1973, seven years before the Equal Employment Opportunity Commission (EEOC) issued guidelines addressing the subject, according to Mary Rowe, special assistant to the



president and campus ombudsperson.

President Jerome Wiesner may have had the foresight to bring Rowe on board, but she has given the position stature. She cofounded the Corporate Ombudsman Association and has written on sexual harassment in such publications as the *Harvard Business Review* and *Negotiation Journal*. Her efforts, along with those of others, have put MIT "at the forefront in dealing with these issues," says Linda Wilcox, ombudsperson for the Harvard medical area. "Nineteen years is a long time to have had a grievance procedure to deal with issues like sexual harassment."

Similarly, consultant Freada Klein has only high praise for MIT. President of Klein Associates, she worked with MIT on its most recent policy and, like Rowe, is a pioneer in this area. "MIT is leaps and bounds ahead of other campuses," she says. "MIT has been far more willing to focus on the practical, human aspect, instead of just seeing it as a legal-liability issue."

"President Wiesner gave instructions to work on the reporting rate, to do whatever was reasonable to make it easy for people to come forward," Rowe remembers. "He had an engineer's concern that faults in the system had to be reported in order to be dealt with." For the past 20 years MIT has had the highest reporting rate, as a percentage of the community, of any U.S. university, says Rowe. "You could argue that this is bad news," she says. "But I think it's because we have a constructive system, where a great many people come forward every year."

She attributes the high reporting rate to two characteristics of the MIT complaint-handling system: it is multi-access and multi-option. "Multi-access" means that sexual-harassment complaints on campus are not the responsibility of any one person or office. An individual who experiences harassment may report it to any supervisor with whom he or she feels comfortable. All administrators, faculty, housemasters, and graduate residents are obligated to take complaints seriously, regardless of the evidence; to treat them confidentially unless the complainant decides on an action that involves investigation; and to offer advice and support. "Multi-option" means there are a number of possible steps for resolving the complaint.

All that notwithstanding, some on campus felt the MIT approach was not sufficient, and in February 1989 a group of about 30 women, mainly students and staff, organized an Ad Hoc Committee Against Sexual Harassment. For many in this group, the issue was personally painful.

Maya Paczusi, '86, PhD '91, relates her experience: Over six months, she was harassed by a fellow graduate student. Once he gave her a ceramic phallus at the end of a class and said it was a "gift" from their first-year class. He frequently came to her lab office, where she was the only woman, calling her profane names and refusing to leave. "It's hard to describe; it was just mindless," she says. "I felt I couldn't have control of my own workspace."

Paczusi first told an administrator, who wrote the offender a letter, which he ignored. She continued to check in with the administrator twice a month over three or four months before she realized that this person was not going to take further action. Next Paczusi told two faculty members in her department. One said he thought the behavior might be sexual harassment, but offered no help. The other suggested she come get him next time she was harassed. "That left me in the position of being a victim again. What if he's not there? Am I supposed to run out of my office and find him?"

Finally, she confronted the harassing student in front of other male students in her office, and the behavior stopped. She realized that she had wasted a lot of time trying to enlist help from people who could not or would not solve her problem. "This is a minor example of how the system doesn't work," she says. "One graduate student harassing another is a very simple thing. I realized later all someone would have had to do was call his adviser and tell him to cut it out, and he would have."

It was the sense that better advice and procedures could save women a lot of grief that motivated the members of the Ad Hoc Committee Against Sexual Harassment. After meeting for two months, they proposed a new Institute policy, which inspired Deutch to convene the Keyser Committee.

The 18-member committee was soon

polarized—women graduate students and support staff versus administrators. The graduate students had been selected from the Ad Hoc Committee Against Sexual Harassment, and they were frustrated to find that after months of work, they were back to square one, defending the need for action. "Jay Keyser would say it's a serious problem, but we still had to convince them and tell what happened to us," remembers committee member Jean Moran, who relates how 15 male students in her dorm followed and threatened her after she complained that pornographic films had been shown in a lounge. And Keyser acknowledges, "When the committee first met, we didn't know to what extent harassment existed in the community. Opinions ranged from, 'This is no different from anyplace else,' to 'It's epidemic.'" Some of the students on the committee felt further exasperated when much of their work for the Keyser Committee was rewritten by administrators.

"It was like pulling teeth," says Paczusi, who served on both committees. "A large number of people in the administration were reluctant to think about doing anything dramatically different from what they had been doing. Maybe it was progressive in the early '70s when they started doing it, but I don't think any of us would regard what we saw at MIT as being progressive in the '90s."

In the end, the committee did adopt some of the Ad Hoc group's policy proposals, drafting a much broader definition of sexual harassment than had been on the books and for the first time addressing retaliation against persons bringing complaints. And it recommended numerous actions in addition to the guide: a three-pronged procedure for handling complaints, better record keeping, and educational and prevention efforts.

Supervisors have been reminded of their responsibilities under the multi-access, multi-option system. The dozen or so remedial measures they have to offer fall into three categories:

- An informal resolution, designed to stop the harassment without making a judgment. This might include confronting the harasser in person or by letter, third-party



intervention, or educational activities in an office or department to put harassers on notice.

■ Mediation—provided both complainant and accused agree. MIT now has 36 trained mediators on staff.

■ A formal written complaint—in which case, a department chair, laboratory director, or higher administrator would convene a special committee to determine the facts. If the committee finds that harassment has occurred, the supervisor who convened the committee is required to take action.

Even before the road map was published, Rowe believed she had evidence that things were improving. In 1989, "my worst [calendar] year in terms of harassment," Rowe had an estimated 1,000 to 1,200 complaints and concerns about harassment and discrimination—roughly three per day. During fiscal 1991, her reports dropped to 770. "The drop could mean people have been driven underground, but I don't think so," Rowe says. Education has made a difference, she says. Numerous workshops and seminars, many by outside consultants, have been given throughout the schools and administrative departments in the Institute, and such efforts multiplied during 1991-92. Students employed improvisational comedy and cabaret-style performances to deliver an anti-harassment message during orientation week and in dorms. The housemasters of East Campus and Baker House surveyed residents about harassment—setting a new campus standard for thoughtful treatment of the subject—and the results were circulated with a cover letter from President Vest. Project Athena developed an electronic "ombudsprogram" called Lucy to allow students to ask questions on various topics, including harassment.

Administrators throughout the Institute repeatedly cite Rowe's numbers as an encouraging indicator. However, the records the administration is keeping have many gaps and are not those the women on



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inaction.*

the sexual harassment committees asked for. "If you say complaints at an office have gone down, maybe people have figured out that's not an office worth going to," Paczuski says.

The committee charged Jay Keyser to make a yearly report in *Tech Talk* of the aggregate number and types of complaints, how they were resolved, and the sanctions that were used. Keyser did make a verbal report at a faculty meeting last October on the number of formal complaints, but there was no mention of how the complaints were resolved, and many of his comments related to educational efforts rather than complaint handling.

Last spring, Keyser surveyed 2,730 faculty and staff, asking for the number and nature of complaints they had received. "It was an anonymous questionnaire, hastily put together, asking questions like, 'Have you ever been harassed? Have you ever heard of students being harassed?'" says Ruth Perry, a

professor of literature and women's studies. "It didn't facilitate the collection of data. We discussed it in our women's studies meeting. There were two social scientists there. It was methodologically nowhere. We wrote to Jay and suggested he should use some of the social-science expertise on campus. He didn't respond."

Keyser is planning to repeat the Baker House-East Campus survey in off-campus living groups and among graduate students. But a survey, with voluntary participation, measures something very different from actual complaint records. A survey may provide a broad sense of the problem, but it does not provide hard data on how many people asked for help and what actions were taken.

Keeping detailed records can help identify repeat harassers and document harassment in cases in which one person's complaint is inconclusive, even when formal complaints are not brought, says Genevieve Hammond, who represented support staff on the Keyser committee.



Sometimes repeat offenders get noticed anyway, responds Assistant Dean James Tewhey. "If a name repeatedly came up anonymously, we would begin our own investigation. I can think of one case where we got three reports about an individual. We went back to the housemasters and graduate residents and found the individual ought not to be living in MIT housing and removed him." Yet that approach only works if complaints come in to the same office, and with a multi-access system, it may be hit or miss.

Administrators like to emphasize the flexibility of the multi-access system as giving complainants more control and forcing all supervisors to take responsibility for the problem. But victims in pain see the system as wrought with confusion and inconsistency, even inaction and avoidance—some of which may be attributable to training of complaint handlers, which even administrators agree is inadequate.

Administrators want to keep the system nonlegalistic—constructive rather than accusatory. They want to address factors that may cause one person to harass another, and they emphasize education, which they believe will encourage complainants to speak out and will prevent some episodes from ever happening. But many on campus say they need tools to deal with specific violations, not just theories, good intentions, and efforts toward long-term social change.

Keyser acknowledges that many women want the procedures to be more formal, and he says that the second edition of the *Stopping Sexual Harassment* guide will have more steps spelled out.

Some women have felt that their complaints about MIT's system are so serious that they have taken them outside the Institute. The federal Department of Education's Office of Civil Rights



*It is  
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for administrators  
or critics  
to evaluate  
how well MIT  
is handling  
complaints,  
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the relevant  
information  
is not  
collected  
in one place.*

has two sexual-harassment complaints pending against MIT. One is a class-action suit filed in January 1990, in which staff and students brought forward personal examples in an attempt to show that MIT does not have clear and consistent procedures, confidentiality policies, and time limits on handling complaints.

Also, the Cambridge Human Rights Commission has an open case of two MIT students claiming that the Institute did not respond adequately to their complaint that another student sexually harassed them.

A graduate student has filed a suit in Middlesex County Superior Court against a professor who allegedly harassed her physically and verbally over seven months and against MIT for its handling of the case. The graduate student claims that after she refused the professor's insistence on a personal relationship and called it harassment, he fired her from part-time field-related jobs and denied approval he had promised

for a research assistantship.

While the court will have to decide the merits of this particular case, it does raise general issues. A campus ombudsperson advised the student to write a letter to her harasser. The student's lawyer, Barbara Johnson, claims that in writing the letter, her client was not only exposed to further trauma, but also risked expressing doubts and feelings that could be used against her in court.

The student's attorney also questions whether it is even possible for someone paid by the university to take a truly supportive role for a harassment victim. She notes that if the complainant becomes dissatisfied with internal efforts and takes the case to outside agencies or the courts, the erstwhile confidant may end up on the opposite side of the table. Instead, "maybe the university should foot the bill for the victim to go to an outside third party as an intervenor" right from the start, says the lawyer.

In Rowe's copyrighted "Writing a Letter



to a Person Who Has Harassed or Offended You," she portrays a letter as helping to build evidence: "You may not be able to prove that the offense took place. But if you send a letter, you can prove that you *thought* the offense took place and that you took a civil, responsible, private action to get the offense to stop."

While not commenting on this lawsuit, consultant Freada Klein supports the letter as an option. "The description of the process that Mary Rowe has available talks very specifically about what should and should not be in a letter, the tone of the letter, getting feedback on the letter before delivering it, how you separate the facts and the feelings."

The one thing missing in MIT's system," says Mary Herndon, a member of the Graduate Student Council, "that absolutely must be there is an advocate" who is unquestionably on the complainant's side, regardless of whether the complaint is resolved quickly and quietly between two people or goes to court. Students have done two things to help fill that void:

Last year the GSC voted to push the administration for even stronger policies on sexual harassment, and Herndon is organizing a group called Peer Advocates Against Harassment. Members will be available to simply listen or to accompany the complainant to meetings and to provide support until a satisfactory resolution is reached.

Other women have tried a different tack. In May 1991 they published—anonymously—*Fight Back: An Underground Guide to Fighting Sexual Harassment*, which takes a victim through a step-by-step evaluation of available options, both inside and outside MIT. The guide also suggests ways of providing support to harassment "victim/survivors" through a four-step process: "listen, believe, don't blame, and validate." Written in the first-person, eminently practical style of *Our Bodies, Ourselves* (one of the classics of women's consciousness-raising), the 80-page underground guide stands in sharp contrast with the 16-page official *Stopping Sexual Harassment*, the heart of which is a list of names and phone numbers.

While administrators acknowledge that

*Fight Back* has many constructive sections, they are alarmed by three pages in the guide that evaluate complaint handlers and identify them by name—praising the support offered by specific people in some departments and criticizing individuals in others through anonymous anecdotes.

Dean Tewhey, whose office was one of those criticized, calls the guide unfair. Bound by confidentiality, those criticized cannot adequately defend themselves, he says. "I will not deny the fact that there are times when in retrospect we felt we could have done a better job," he admits. "But all the specifics in the underground guide would easily be shown to be factually inaccurate if we could open the files. They simply do not reflect what was going on."

An editor of the 1992 revision of the guide, who requests anonymity, argues that when people are in so much pain, the strategy is justified. "People have a right to know someone else had a problem. Who's going to tell you?" But one cost of the strategy, in the opinion of Professor of Ocean Engineering Kim Vandiver, PhD '75, chair of the faculty, is that the personal attacks undermine and discourage precisely those people in the Institute whose job it is to combat harassment.

Not all the Institute's critics are women. For years, according to Professor of Urban Studies and Planning Frank Jones, several professors in his department have been known to harass female support staff and students. Yet other faculty turned a blind eye, he claims, and few women were willing to come forward. Jones says that an environment must be created in which supervisors will take known harassers aside and let them know their behavior will not be tolerated, even if there are never any charges, investigations, or sanctions.

Dean of Student Affairs Arthur Smith agrees that changing the climate is the key. "Our best hope is to reduce the occurrence," he says. "That's where most of our effort has gone, making it clear that we will treat sexual harassment seriously. That's what we can do best—convince predominantly intelligent people to behave better toward each other."

What can be concluded? Handling sexual-harassment complaints is relatively new territory that must be explored by

every employer, every university. It is clear that some mistakes will be made as policies and procedures are implemented and refined. It is also clear that MIT could be doing a better job.

At present, no one—from the highest administrative officer to students who feel themselves wronged once by a harasser, then wronged a second time by the complaint-handling system—can evaluate how the Institute as a whole is performing on this issue. The information is not available. It is not compiled in one place.

Compounding the difficulties of self-evaluation and record keeping is the confidential and anonymous nature of the issue. Complainants usually expect confidentiality, and such feelings are understandable. People who have invested years of effort as students or employees at an institution with MIT's international status fear they may be risking their careers to accuse harassers or complaint handlers in positions of power. They must believe that anyone in whom they confide will be both effective and trustworthy and can protect them from retaliation. That kind of confidence and trust must be built.

On the other hand, complainants who are satisfied with their treatment by the system rarely make it known. They likely want to put the incident behind them. Or they may fear that their reputations will be questioned publicly long after the complaint is resolved in the Institute's system. As a result, administrators and complaint handlers cannot point to successful cases that might help them build trust. At the same time, administrators have been unwilling to publicize sanctions they have taken.

Some of the underlying issues in matters of sexual harassment are similar to those in cases of alleged research fraud: At what point does an internal investigation become inappropriate? And should someone employed by an institution that also employs the accused be advising a person making a complaint?

Unless these problems can be overcome, this issue has the potential to further divide men and women, administrators and students, employers and employees on the campus. □

KIMBERLY FRENCH is a freelance writer and editor living in Middleborough, Mass.



# Capturing Smoke

## Or, Teaching Creative Design

A few summers ago, Donald Schön was playing tennis on Martha's Vineyard. In the next court, he recognized someone he had not seen in close to five decades—a man who had been his classmate in eighth grade. The two fell to talking, and the classmate asked what Schön had done with his life. When he explained that he had become a philosopher, the classmate began to laugh. "Don," he said "you always were!"

That philosophical bent has been shaped by two decades of labor in a decidedly practical field—urban studies and planning—where Schön has held the Ford professorship in the School of Architecture at MIT since 1972. He became head of the department in 1990, when Tunney Lee left the Institute to head up a new school of architecture and planning at the Chinese University of Hong Kong, and Schön handed over the reins of the department to Phillip Clay, PhD '75, in July.

Schön is a tall, lanky man with a steady gaze. He has been an academic, a business consultant, and a government bureaucrat, but as his colleague William L. Porter, PhD '69 and Leventhal Professor of Architecture and Planning, remarks, Schön's resume has at least one common thread. "He's tremendously interested in change and being an agent of change, not for the sake of change itself, but for the sake of the increase in information, knowledge, and insight that comes from carefully considering a new set of ideas."

How people make inferences—how they learn—has been Schön's central interest since he studied literary theory at Yale and wrote a doctoral thesis on rationalist philosopher John Dewey at Harvard. Yet only two years after the ink was dry on his PhD, he left academic philosophy and went to work for a consulting group concerned with new-product development and technological innovation at Arthur D. Little.

The ADL group was, for perhaps the first time, applying psychotherapeutic models to organizational life and the inner workings of corporations. Schön and his colleagues began to identify the similarities and differences among various "corporate cultures" (indeed, Schön's group coined that term). They found that "different ways of looking at key issues of knowledge, error, and uncertainty"—that is, different ways of learning—influenced a company's



Don Schön

ability to solve problems and generate successful ideas.

Schön went on in 1963 to head the Institute for Applied Technology at the National Bureau of Standards, where he focused on civilian industrial policy. Three years later, he started a Boston-based, nonprofit consulting agency, the Organization for Social and Technical Innovation, that designed and implemented a number of Kennedy-era antipoverty and social services programs.

As he turned his attention to these very different kinds of organizations, he began to notice how often professionals such as architects and therapists seemed to roll up their sleeves and try out different possibilities based on their own experiences. As they recognized unintended consequences of their proposals, they would generate new options, many richer than the alternatives that they had originally conceived. Schön calls this practical, unbounded process "reflection-in-action" or a "reflective conversation with the situation."

Not surprisingly, then, Schön's teaching is typified by a commitment to giving his students hands-on design exercises. In the course "Design for Learning and Learning to Design," which he co-teaches with Jeanne Bamberger, a professor of music and theatre arts, he tries to get engineering undergraduates to focus on the basic unit of a structure, to consider the implicit and explicit relationships between the parts of a design, and to explore the broader-than-expected possibilities in unpretentious materials such as LEGOS and Tinker Toys.

In another subject at MIT, which Schön team-teaches with Edith Ackerman of the Media Lab and William Porter, architecture students play the "silent game," where they try to decipher the design "laws" and patterns other students are demonstrating as they build a LEGO structure—and from the misunderstandings and mistakes, learn how opaque and ambiguous communication can sometimes be.

Schön's embrace of improvisation, his lack of belief in "right" answers, and his skepticism about the value of trying to reify broad-based "eternal" theories to "apply" to narrow, individual cases drives some of his students to distraction. Others see what he's getting at.

James Thomas Rojas, SM '91, now a long-range planner for the city of Santa Monica, points out that "a lot of people are intimidated by his mannerisms, his probing." His leading questions can seem "manipulative," even though Rojas believes that this is a strategy to help students sift truly valuable solutions from the myriad of possibilities. "In each conversation about a project we're working on together, Don listens wonderfully," says Porter. "He is able to pull out of what you said more than you realized was there—and he has a way of playing it back so that the conversation builds toward some inferences."

As Schön practices them, conversation, teaching, learning—and the construction of a life's work—become types of design, a way that "the unfamiliar situation is made understandable in the light of the familiar." All of us, Don Schön argues, go through life improvising in new situations. The challenge lies in following those insights and the complexities that emerge from them into fresh, uncharted worlds.—Debra Cash □





## 17

**Leslie B. White**, longtime resident of Easton, Mass., died March 5. He graduated from Clark University in 1916 in chemistry and then took work at MIT in biology with our class. He joined Simpson Spring Co. of Easton in 1918, retiring from its presidency in 1978. During World War II, he worked for the U.S. Public Health Service in Arkansas.—**Don Severance**, acting secretary, 39 Hampshire Rd., Wellesley, MA 02181

## 18

I have received no news recently of class members. I regret I cannot do more at this time. I am planning, however, to be at Technology Day, June 5, at MIT and hopefully have some news for the readers of *Technology Review*.—**Max Seltzer**, secretary, 865 Central Ave., Needham, MA 02192

## 19

Classmate **Robert "Bob" MacMullin** finds that one sees and learns a lot while walking. He chanced to notice Sputnik and Halley's Comet this way. I wrote him that I also spotted the light from Sputnik in Chicago one evening while walking, and in New Jersey the head and tail of Halley's Comet during its passage over our planet. So, we approve of walking and am happy that on two occasions I walked with Bob. I am sure others of our class share his walks when we can. Bob was 93 last September. He is slowing down but keeps limber and mentally active by inventing solutions to global problems and politics.

We sent a copy of our Class of 1919 25 Years After to **John A. Maynard**, which he read cover to cover. His father appeared in two group pictures and was mentioned in the reunion write-up.

Here's wishing you all a pleasant summer. I remain—**Bill Langille**, secretary, P.O. Box 144, Gladstone, NJ 07934

## 20

Please send news for this column to: **Harold Bugbee**, secretary, 313 Country Club Heights, Woburn, MA 01801

## 21

In a conversation with Class President **Cac Clarke**, your secretary learned that Anne (Mrs. Wallace T.) **Adams** died recently. Anne and Wally were regular attendees at our five year reunions. Wally died some years ago.

That is all the news this month, and it may be noted that with our class in their 90s, this is the kind of news that will continue to come in.—**Sumner Hayward**, secretary/treasurer, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

## 22

Your new secretary finds it difficult to fill Yardley's shoes. I am, however, happy to report some good news. Born in 1901, **Bill Elmer** has set himself a project of living out a complete century. He is in good health. While in Florida, he spent his time writing *The Optical Design of Reflectors*. He is getting his fill of orders, which come from all over the world. When Bill was a freshman, his first *Voodoo* cartoon was accepted. Since then, he has designed several, and one of his best drawings was reprinted in a recent issue.

Unfortunately, I must announce the death of one of our classmates—**Clifford B. Morse**, November 4, 1990.

As I write this, I'm hoping that some of you will have made it to our 70th reunion. What a milestone!—**Martha E. Munzer**, secretary, 4411 East Tradewinds Ave., Lauderdale-by-the-Sea, FL 33308

## 23

### 70th Reunion

Please send news for this column to: **Frederick O.A. Almquist**, secretary, 19 Griswold Rd., Wethersfield, CT 06109

## 24

I was so pleased to receive a delightful letter from **B. Alden Cushman**, "Cush." He just celebrated his 90th birthday. His wife, Beatrice, "... gave a marvelous party at the Woodward Country Club—dining, dancing, and great good cheer." He says he is still dancing, but a little more conservatively than in the "old days." About 65 attended, mostly family and a few old friends, including **Dave Evans** and wife Dorothy; **Phil Niles**, '25, and wife Kay; grandson **Tom Ransokoff** and wife Betty, both '84. A surprise feature was a TV film of old family pictures, with comments, done quite professionally by a granddaughter and husband who is VP of C-SPAN.

Beatrice and Cush have each been married twice before, having lost their former spouses. Together they have 34 grandchildren, including "steps," and 11 great-grandchildren. He says it makes it a bit difficult to remember birthdays, not to mention Christmas. I would think so!

The Alumni/ae Association informed me of the passing of **Harry J. Stievater** on July 1, 1991. He was 90 years old. A graduate of St. Joseph's Collegiate Institute, he earned a bachelor's degree in chemistry from Canisius College in 1922. His bachelor's degree from MIT was in chemical engineering. Harry was superintendent at Lucidol Corp. for 18 years. He formed Cadet Chemical Co. in 1924 and retired in 1966. He was a past director and secretary of Buffalo Canoe Club in Point Abino, Ont., and was known for his performance at German Night festivities at the club. He played the piano for more than 80 years and was a world traveler for the last 25. He is survived by his wife of 58 years, the former **Ruth Geiger**, a daughter, two sons, a sister, and 17 grandchildren. Our sympathy to all the family.—Co-secretaries: **Katty Hereford**, Box 5397, Carmel, CA 93921; **Col. I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

## 25

**Milt Salzman** writes that physically he is in good shape but roads seem steeper and time moves faster. As most of you know, Milt loves singing and he continues with his barbershop chorus and church choir. Last January he took an air/cruise with a singing group to Montego Bay, Panama Canal with partial transit, and then to Cartagena, Colombia, and the Caribbean Islands of Aruba and Curacao. In May he planned to go to Cornell to see one of his three granddaughters graduate. He has a granddaughter in West Barnstable, Cape Cod, so we hope he will come this way in the near future.

The passing of six classmates must be reported. ... **Leslie Bragg** died February 24, 1992, in Auburn, N.Y. Les went on to graduate school after 1925 and earned a doctorate. He was a member of the American Institute of Chemical Engineers and the American Chemical Society. He was president and owner of the Packed Column Corp. and held four patents in the field of distillation equipment. He is survived by his wife, **Clara Bragg**, two sons, and a daughter.

**Leroy J. Davis** died at Doylestown Hospital in Pennsylvania on November 27, 1991. He was employed by the Philadelphia Electric Co. as a mechanical engineer and retired in 1966 after 39 years with the company. He was a 33rd-degree Mason and was active in several Masonic orders. He is survived by a son and daughter.

**Louis F. Kreek** passed away at the Georgetown University Hospital in Washington D.C., on March 24, 1992. He worked in the U.S. Patent Office from 1928 to 1970. He had attended Northwestern University before coming to the Institute and later graduated from the George Washington University Law School. Judge Kreek was appointed examiner-in-chief of the Patent Office by President Eisenhower in 1956 and served as chair of its Board of Appeals. He is survived by one son and one daughter.

**Robert D. Barnes** died in Milwaukee on January 2, 1992. ... **Ray E. Lucey** passed away in Fort Lauderdale, Fla., on February 3, 1992. ... **Samuel B. Maddock** died in 1991 in Portsmouth, N.H. No details are available regarding these three classmates.—**F. Leroy (Doc) Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, N. Chatham, MA 02650

## 26

Since our last update I've received almost nothing except death notices. While we reluctantly like to be updated in this area, we'd like to know what the living are doing, so send me your letters and articles.

**Charles W. Show** reports that he's 87, a retired widower, is lucky as he has a full head of hair, all his own teeth, and excellent vision, though he has a bit of arthritis. He has children, grandchildren, and great-grandchildren.

We've lost a number of classmates as follows: **Philip S. Mancini** passed away January 29, 1992. Originally from Italy, he lived in Rhode Island until retiring to Beverly Hills, Fla. He worked as head of the Public Works Department of Rhode Island until his retirement. He was a member of the National Safety Commission under President Eisenhower and was instrumental in the development of limited access highways across America. He was a past president of the New England Institute of Traffic



Engineers and a member of the Knights of Columbus. He leaves his wife, Catherine, three sons, a daughter, two sisters, ten grandchildren, and a great-granddaughter.

Retired Navy captain **Francis H. Whitaker** died February 9, 1992. Born in Tyler, Tex., he graduated from Rice University and received a master's degree in naval architecture from MIT. He served at Pearl Harbor and was in charge of ship salvage work, ultimately righting and refloating the *Oklahoma*. For his work there he received the Legion of Merit, and the Linnard Prize from the Society of Naval Architects and Marine Engineers for the best paper of the year in 1944. After serving in several other capacities, he retired in 1953 as supervisor of shipbuilding at Quincy and inspector of Naval Shipbuilding in Massachusetts and Rhode Island. For the next five years he was an official of the Union Cabride Corp., from which he retired in 1958. A resident of Westfield, N.J., for many years, he moved to Chesterbrook, Pa., in 1985. He served as president of the U.S. Naval Academy Association of New York. He was active in the Unitarian Church and in the Men's Horticulture Club in New Jersey. He is survived by two sons, six grandchildren, and three great-grandchildren.

**Robert W. Conly** died at his home at Crosslands, in Kennett Square, Pa., on March 18, 1992. He is survived by his wife, Ruth, and reportedly had the energy and enthusiasm of a man of 50.—**Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

## 27

In last month's notes I reported the death of John H. Weaver, whose name should be corrected to **John H. Wever**. He was 91. . . . **Stanley C. Boyle** of Indianapolis, Ind., died January 29, 1992. Having a degree from the University of Notre Dame, he received an SM in our class in electrical engineering. He joined General Electric and was a member of the Hotpoint Research team that developed the electric stove heating coil. He worked for 38 years for Reilly Industries, retiring as purchasing manager in 1971. He served as Indianapolis chapter president, regional VP, and later national director of the Purchasing Agents Association.

According to his two daughters, his last year, spent at Marquette Manor, was rich in activities and service. He enjoyed frequent outings with his children, grandchildren, and friends, and loved reading to preschoolers. He waged a one-man campaign to buoy up the spirits of other residents.—**Joseph C. Burley**, secretary, Isle of Springs, ME 04549; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

## 28 65th Reunion

At the time you will be receiving this issue of the *Review*, we will be well on the way to our 65th. You should have received communications from a planning session in April. It promises to be a fine get-together for those who attend, thanks to the many individuals and agencies involved.

A request has been received from **James M. Farnum** of Lee, Mass., for the address of **Louis Brunton Bauer** of Solvang, Calif. After all these years it is good for classmates to renew contact and we are glad to assist in any way possible, even to just mention once familiar names. Better still is the possibility of encouraging the renewal of interrupted friendships.

We again have announcements of deaths to report. **William Holgate (Bill) Phillips** died in 1990. We have no further information. . . . **Henry Fred Kohler** died January 21, 1992. Henry graduated from both University of Texas and MIT and was a chemical engineer with Esso and Amoco. . . . **Robert Walker (Bob) Hunn** passed away on January 1, 1992, at Quartz Hill, Calif. Those who were at our 60th Reunion will remember that Bob attended and brought with him a son and grandson, both graduates of MIT, who he introduced to the class

and also the class to them. A fine example of two-way loyalty. We offer condolences to all family and friends.

A last minute report from **Herm Swartz** who attended the "Reunion Kick-Off 1993" dinner last night together with Frances (Mrs. **James**) **Donovan** and Florence (Mrs. **Walter**) **Smith** with Dorothy (Mrs. **Herm**) **Swartz** performing chauffeur service. It was a well-attended and well-presented affair with representatives from all classes having reunions in 1993. There is little solid information to transmit at the moment but our star-studded committee and Alumni/ae Association personnel will do well by us in the coming months.—**Ernest H. Knight**, secretary, Box 98, Raymond, ME 04071, (207) 655-4231

## 29

**Chung F. Yee**, Worcester, Mass., says "My wife and I are enjoying good health. Though the winters in Massachusetts are very cold, we are more or less used to it." . . . **Arnold W. Conti** (wife Mary) of Atlantic Beach, write: "We have only six grandchildren, the oldest of whom is almost 10. Mary and I married late in life—maybe we were both retarded adults. Mary is busy with her painting and still winning ribbons. Pretty soon she will have to stop because we have run out of wall space to hang them (including the garage), and they are all stacked up under the beds, so much that we now have a very firm mattress. I serve on the President's Council in this retirement project—time consuming and at times aggravating but none the less a fulfilling experience if you can ignore those who want to be cared for from womb to tomb. I also serve on the board of a HUD project, one that is held up as an example of excellence by HUD. We are now in the planning stage of a \$12 million expansion. This past week has been spent interviewing six architects. Next week comes the budget and site selection. Some day I'll get back to golf—my bones ache and my joints creak and the chronic complainers give me headaches (not to mention pains elsewhere), but by doing all these good things, I feel that I am making amends for all the sins of my youth." . . . **Fred S. Eastman** (wife Louise) of Medford, Ore.: "Vision and hearing problems have slowed me down a bit, but we substitute bus rides and tours in our own car when a relative visits who likes to drive around the beautiful country roads in Oregon and northern California. In good weather, I lead a small group of walkers. Our favorite walk is on the bicycle trail along Bear Creek—three miles, including return, to our favorite restaurant for breakfast. Yes, life is great here and I am very fortunate!"

**Bill Bowie** and wife Sally of Oldstedville, N.Y.: "We are still under our own power but do not have the old get up and go. I don't know if we can make it south next spring, although we would like to." . . . **Frank Mead** of North Port, Fla., sends greetings to all. . . . **Joaquin Llanos** and wife Dorothy of Woodlands, Tex., send greetings to all. "This year we did not leave the state of Texas. However, with our granddaughter Amy, we toured the eastern portion of the state. We went 1,000 miles by car visiting San Antonio, Austin, and Dallas. It took us a week to recuperate after we returned to Woodlands."

**Wes Walters** and wife Josephine of Saint Paul, Minn.: "We have added two more great-grandchildren to our list making the total nine. Best wishes to all." . . . "The world of engineering research and education may not yet have seen the last of the rich **Hunter Rouse** legacy," states his biographer, Britt Kennerly, *Daily News Sun* staff, adding his name to a distinguished group of past recipients that include Thomas Edison, Orville Wright, and Alexander Graham Bell. Sun Citian Rouse has been named the 1991 recipient of the John Fritz Medal for "pioneering the application of fluid mechanics to hydraulics. Rouse's theories and experiments date back to the early 1900s and were a vital part of the development of the standard scientific thinking that is now a basic premise of hydraulics study."

A letter comes from **Richard E. Bolton** of Westmount, P.Q., Canada: "Thank you for your birth-

day greetings and wonderful letter. I hope that writing does not put too great a strain on your eyes. The new techniques for cataract operations are simply miraculous and I am sure you will feel liberated when it is over. What a dreadful year you have had, and how wonderful that Helen has survived and is recovering! As you say, life without her would have lost its meaning. I know all about it. For eight years I watched my Betty slowly going downhill, unable to speak at the end. After her death, I wept every day for over a year and still do but less frequently. You don't get over it, you change in some mysterious way and become grateful for what you once had. We have always been a serious church-going Christian family but now I have come to take my religion very seriously indeed, but not, I hasten to add, fanatically. Your description of the flood and loss of equipment, new car, etc. must have been the final blow, trying to get everything settled before leaving for Florida. My health is improving but one can't expect to set back the clock. It takes twice as long to do half as much. The father of an old friend once said to me that a man over 80 is like a car with no brakes—it tends to go downhill awful fast." . . . **Henry F. Robbins** and wife Anne of Gillette, N.J.: "Anne and I just completed a 3,223-mile trip in our new Saturn four-door, visiting Stuart, Fla., and Spring Hill, Tenn., averaging 39.9 MPG with automatic transmission."

I regret to announce the deaths of the following members of our class: **Harry F. Dickinson**, Fortuna West, Fla., September 20, 1991; **Archie Wolbarst**, Arlington, Va., September 29, 1991; **Charles A. Whitney**, Santa Monica, Calif., November 24, 1991; **John T. Hallahan**, New York, N.Y., February 25, 1992; **Almer F. Moore**, Birmingham, Mich., March 10, 1992; **Floyd W. Buck**, Hamden, Conn., January 15, 1992.

**Charles A. Whitney's** career as a mining engineer took him to South America, Alaska, and numerous areas of the United States. He met his future wife, Josephine McCarthy, while working in Cripple Creek, Colo. They were married in 1935 and lived in Seattle for a number of years. During World War II, Whitney served in the U.S. Navy, specializing in the repair of gun turret mechanisms on active duty ships. A lieutenant senior grade, he was headquartered in Pearl Harbor. In 1945, after the war, the Whitney's moved to California and became associated with Southern California Edison Co. Upon retiring, in 1971, Whitney became a freelance technical writer, a career he followed until the mid-80s. His wife died in 1960. He leaves a brother, sister, one niece, and five nephews. . . . **John T. Hallahan** lived in New York for 50 years. He was a civil engineer working for the federal government and practiced after retirement as a consulting engineer. He leaves a sister, Kathleen M. Ahern of Peabody, and two nieces.—**Karnig S. Dinjian**, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364; (603) 926-5363

## 30

This month we have a report from **Parker Starratt**, our second class secretary. (For the record, I have had three predecessors: **Hijo Marean**, 1930-35; **Parker**, 1935-55; and **George Wadsworth**, 1955-60.) **Parker** worked for Bethlehem Steel, first in the shipbuilding unit in Quincy, Mass., for 33 years and then in Bethlehem, Pa., for 8 years. Upon retiring, he and Dorothy moved to Hancock, N.H. After acquiring an MBA from Lehigh in 1971, **Parker** began a second career teaching business courses at Nathaniel Hawthorne College in Antrim, N.H. He retired as Professor Emeritus in 1981. His retirement activities include continuation of his longtime interest in ham radio (K1BUR), church choir, and town auditor.

**King Tow** and his wife, Kim Chu, celebrated their 60th wedding anniversary in 1991 with 300 people attending a banquet hosted by their 5 children and spouses and 13 grandchildren. The grandchildren put on skits depicting King and Kum Chu's schooling, courtship, and migration to the United States. . . . **Helen Lustig Thornton** still



lives in Holmes, N.Y. (Dutchess County). The offspring she listed include a daughter, three granddaughters (including twins), and a great-granddaughter. She still does volunteer work at the library, plays bridge, and attends concerts. . . . **Ed Mears** and wife Edythe recently celebrated their 60th wedding anniversary. They live in Meadowood Retirement Community in Lansdale, Pa., and are expecting their first grandchild. Ed was a past master of the Lexington, Mass., Masonic Lodge and was recently presented with a 50-year pin by the Masonic Lodge in Lansdale.

Doris and **Les Engler** are still shuttling between a summer home in Quechee, Vt., and a winter home in Ft. Lauderdale, Fla., doing volunteer hospital work at both locations. They "keep busy and enjoy life." . . . **Maggie and John Scheuren** are planning a spring trip that includes a flight to Paris; a stop at John's ancestral German home, "Scheuren über Reinhard"; a visit with John's "fellow Fellow of the Explorer's Club, Dr. Ulrich S., just back from Papua"; and a few days at Cliveden in England. We have notices concerning the deaths of two more classmates—**Milton Mezzoff** on February 25 and **Bob Rypinsky** on March 21. . . . Milton was a long-time resident of Providence, R.I. The record at hand suggests that in pursuit of his degree in Course VII he acquired expertise in the field of food technology, taught for a time at Boston University, and for many years was proprietor of a commercial bakery in Providence. After retirement he assisted in the establishment of the Washington Park Community Center and Citizens Association. He was a member of Temple Am David and was involved in its social service activities. His wife, Bertha, survives him.

Bob Rypinsky's death was reported by **John Scheuren**, whose friendship with Bob started at MIT, continued throughout the years, and included professional associations. John says he and Bob collaborated on a proposal for the "lunar soft landing" when Bob was chief engineer of Chrysler's Missile Division and John was VP and overseas manager of Metcalf & Eddy. Bob also worked for TRW at one time. His retirement activities included recording technical textbooks for the blind and working with the Audio Engineering Society; (he chaired its 57th International Convention). He also spent "a lot of time on calculators such as HP41, TI 59, and Radio Shack's TRS minicomputer." He is survived by his wife, Doreen.—**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

## 31

This month's report is a bit unusual. It seems that a number of graduates from other colleges want to do graduate work in a particular technology, but the Institute finds that they lack some of the prerequisites. Those individuals are arbitrarily assigned to the senior class that year and go on to get an SB with that class when the necessary courses are completed. Several of those members have recently passed on.

One is **Doyle Langdon Northrup**. It seems Doyle was from Washington and went on to get a master's in electrical engineering. "A physicist who detected the Soviet Union's first atomic bomb explosion, he died December 15, 1991, at the age of 85," according to the *San Francisco Chronicle*. He was retired and living at Satellite Beach, Fla. He died of natural causes at the Holmes Regional Nursing Center at Melbourne, Fla., according to his wife. In 1940, he joined the Naval Ordnance Laboratory and was assigned to demagnetize ships at Pearl Harbor to foil magnetic sea mines. In 1948, he transferred to the Air Force and worked as technical director of its Technical Applications Center and its Special Weapons Squadron. He was assigned to a top-secret project to test radioactivity from planes and to monitor seismographs to watch for Soviet weapons testing. In 1949, the system uncovered the first Soviet test explosion, which he reported to President Harry S. Truman. In the 1950s, Doyle served as scientific adviser to the American delegation in Geneva at negotiations to ban nuclear testing and to control weapons.

**Robert (Bob) G. Marcus (XV)**, of Princeton, N.J., died January 16, 1992, at Eisenhower Medical Center, Rancho Mirage, Calif. In 1935 Bob was a salesman for Puritan Rubber Manufacturing Co. in Trenton, N.J.; in 1940 general manager of the firm; and in 1956 VP and general manager of American Biltrite Inc. He was a member of Har Sinai Temple in Trenton and served on its board of trustees. He was also a Mason and a member of the Shrine. Bob is survived by his wife, Natalie Snider Marcus, two sons, and four grandchildren. Memorial contributions may be made to Greenwood House, Trenton, or to the charity of your choice.

**Samuel Brentnell Pritchard**, a Boston native, held government positions with the Federal Communications Commission and with the Bureau of Internal Revenue before he was appointed to the Examining Corps of the U.S. Patent Office around 1936. Except for an interruption of active duty with the Navy (1943-45 active duty in Boston as Lt. commander USNR), he remained in the Patent Office as a supervisor and classifier, attended Georgetown Law School, and obtained a law degree (patent attorney). By 1975 he had retired to St. Petersburg, Fla., but recent mail to him there has been returned with the notation "deceased." If anyone has any information, it would be greatly appreciated.

**Arthur Charles Sugden** is deceased, but there is no information as to when or where. I did find some background in our 25th and 50th Reunion Books and in our Alumni Directories. After MIT he went to Europe and Russia with the idea of working in Russia. Russian food and working conditions were not good, so he returned to the U.S. and started working with General Electric, where he completed an advanced course in engineering in 1934. He did lightning investigation and high-voltage research in Pittsfield, Mass.; obtained the first simultaneous oscillograph and high-speed photograph of natural lightning in GE's New York office; was involved in the Manhattan Project; and worked for the Long Island Lighting Co. No information relative to his wife, Virginia, or their children was found.—**Wyman Boynton**, secretary, 668 Middle St., Portsmouth, NH 03801

## 32

This will be the last class notes written before our 60th Reunion. I will concentrate my attention on those classmates who wanted to come but just couldn't make it. . . . **Minot Bridgham** has three family functions in early June. Two grandsons graduate college, and one granddaughter will be married. Minot has enjoyed his 20 years of retirement. He has developed angina. This has slowed down his activity, especially golf. Lawn bowling is now his main activity. He hopes to come to the 65th and sends his best to all classmates who can attend. . . . **Benjamin Chadwick** writes that when he and his wife, Marion, returned from a trip to Yuma, Ariz., they were jolted by the news that the dates of our 60th Reunion were the same dates that they were being feted by their family (16 members so far are coming). Two houseboats had been hired for a week for a trip on Lake Powell on the border of Arizona and Utah. It was a busy year for the Chadwicks—much travelling and some Elder Hostel participation. Their Chevrolet has gone 400,000 miles (second motor). It has been painted and is now good as new. Ben has had a cataract operation and much dental work. He can now see, hear, and chew. He sends his greetings to his classmates and hopes to see us on our 65th. . . . **Elton Buckley** writes us that he probably won't be able to make the 60th. He enjoyed receiving our class directory. Seeing the names of so many of his classmates brought many memories to him. His wife, Grace, and he had a few poor years with heart attacks and other ailments, but now they are enjoying good health. Elton heard from his friend **Bill Walsh**, who is now living with his second wife (a sister-in-law of his first). Elton was an avid golfer with a 10 handicap at one time. Because of his eyes, etc., his handicap increased to 93, so he gave up the game. (secretary's note: How many of us would love that

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quality of golf!) Elton had a very enjoyable professional life working as a chief chemist for several finishing metal plants. Now that the family has flown the coop, they are living in smaller simpler quarters. Don't get him started on his grandchildren!

Robert Billings also sends his regrets. He enjoyed receiving our class directory. One name he saw—**Santosh Kumar Jana**—reminded him of how Sana got a group of XA cooperative students out of real trouble. I quote: "Director Ed Cooper at Bangor Station had taken a group to Mount Desert Island where we climbed from the parking lot to the top of Mount Cadillac via the paved road. From the top we could look down on the parking lot directly below, and about half of us, foolishly, decided to bush-whack it directly down. Soon we found ourselves off course and opted to follow a stream downhill (it must come out somewhere). It didn't and shortly we found ourselves skirting a swamp. We never felt really lost for by the time we got around the swamp we were guided by the sound of autos and trucks ahead. Some time later we emerged on an unknown road, heavy with traffic. We tried a variety of thumbing techniques, but the cars all sped by without slowing down. Finally one car pulled off the road far ahead, and we learned of our dilemma. Maine had just passed an anti-hitchhiking law, and it was being strictly enforced! Now Jana was extremely dark complected and had very recognizable features. Our rescuing driver worked at the plant, spotted Jana, and decided to risk stopping. Even so, he wouldn't pick up the group but agreed to take a single member back to the parking lot (on the other side of the mountain) to reclaim our car. The rest of us had to possess our souls in patience and wait until he returned.

Hazel and Bob Billings consider themselves in reasonably good health in spite of earlier medical problems. They do a lot of walking and gardening. Summer months are spent in Barnard, Vt., then back to Wilmington to harvest their major crops. They love it! ... **James Paynter** and **Howard Quigley** regret not being able to make the 60th but were glad to get the class directory. They send greetings to their classmates. ... We have received news that **Charles Davis** died in early 1991. We will pass on obituary information when we receive it.

Next class notes will be about those who did attend the 60th.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

## 33 60th Reunion

**Mal Fleming** died August 12, 1991. He was a good friend of many of his classmates, including your secretary. Muriel writes that "his years at MIT were highlights of his life." Many times we talked about those years and the good friends he always remembered. He was employed as plant manager of U.S. Gypsum in Warren, Ohio, and Jacksonville, Fla., and, in his later years, formed Fleming-Joffe Ltd., a tanner and manufacturer of shoes and clothing. He served as lieutenant in the Navy attached to Bureau of Ships and was president of Friends of the Library and Board of Governors of the Home Rule Party, the Rockville Centre United Fund, and was active in Scouting and Masonry. ... **Warren G. Webster** died March 3, 1992. He worked for General Radio, now Genrad, 1934-1968. His widow, Mrs. Eleanor Hutchinson, lives at 219 Lincoln St., Lexington, MA 02173. Could get no further information from Genrad as their computer was mixed up.

**Harry Summer**, 737 Ridge Ave., 4J, Evanston, IL 60202, reports on his and his wife, Cele's, recovery from a very bad automobile accident a year ago. They've recovered sufficiently and were able to go to California, where they saw **Mel Ehrlich**. ... **Bill Pleasants** is still working as an engineering consultant, Box 82, Bethel, DE 19931. He has been made a director of the State Department of Natural Resources Advisory Committee for the Nanticoke River Watershed and has found an alarming increase in the nitrate level from low-cost housing and the need for a central sewer system.

Friends and classmates, that is all the information your secretary has to report.—**William B. Klee**, secretary, P.O. Box 7725, Hilton Head Island, SC 29938

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Please send news for this column to: **Robert Franklin**, secretary, Box 1147, Brewster, MA 02631; **George Bull**, assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

## 35

**Walter "Stocky" Stockmeyer** writes from his home in Norwich, Vt., that he and Sylvia had a nice visit from **Howard Mason** and his wife, Margaret, last October. They live in Portland, Ore. Howard is in good health, Stocky reports, and keeps busy as a "retired" biochemistry professor at the University of Oregon Medical School. The Masons also raise orchids. Stocky hit another milestone last October when he climbed Mt. Isolation, #48 of the 48 mountains over 4,000 feet in the White Mountains of New Hampshire, the last of his post-70 round, making a total of three complete rounds—a lot of climbing. On this last trip he was accompanied by one son, two grandchildren and one dog. "Next summer I'll become a trailbagger rather than a peak-bagger," he says. This May he will be off to Japan on a two-week scientific trip. In June he expects to be in another concert with soloist Janet Ahlquist—he will be the "orchestra."

For a change I have something a bit out of the ordinary to report. On March 31 during my Tuesday morning golf at Welks Fountain course, I had a 41 front nine, hit my drive on the twelfth into a lateral hazard, then made a costly mistake: I started down after it. I slipped, fell, and heard a crack as I hit bottom. My three friends dragged me up on the level where I stood up, found I could walk, tried to swing a club, and found my left ankle refusing to cooperate. I drove to the clinic, got x-rayed, had a splint put on, and reported to Orthopedics in downtown San Diego the next day. I had a 3-inch crack in my left fibula just above my ankle and was put into a cast and given crutches. My life style immediately changed. Another X-ray on April 15 showed I had healed, so no more crutches, and my cast will be removed May 5. I expect to be back with my foursome the morning of May 12 and have decided not to go after any more wayward shots. It's amazing that even at 79 education never stops.

I regret having to report the death of Joseph L. Fisher, who was in our class for the freshman and sophomore years. He died February 2, 1992, in Arlington Va., after a five-year struggle with cancer. He spent his junior and senior years at Bowdoin College, then earned master's and doctor's degrees at Harvard. In 1960 he became president of Resources for the Future and during his 15 years there developed an interest in local politics. In 1975 he was elected to Congress from his home district in Virginia and served 1981. He was appointed chair of the Mass Transit Authority and later was assistant to the president of George Mason College. He is survived by his wife, Margaret.—**Allan Q. Mowatt**, secretary, 715 N. Broadway #257, Escondido, CA 92025-1880

## 36

A reply to **Pat Patterson** from ex-president **Tony Hittl**: "Your New Year's note arrived while I was in the hospital recovering from a quadruple bypass ... about back to normal now, except for morning and afternoon naps. Had been having angina pains occasionally for 10 years, but they came on heavy after Christmas. We are planning a motor trip, perhaps to Oregon, with daughter Barb and husband from Austria." Sounds encouraging! ... From Jane and **Wiley Post**'s 1991 newsletter: "As current president and first lady of the Scottish Society of Lehigh Valley, we had the great thrill of



receiving the salute from the Cold Stream Guards Band and the Queen's Own Highlanders Bagpipe Band at the Bethlehem (Pa.) arena before 2,000 people!"

Phoebe and I were saddened by the report of Dean Margaret MacVicar's death (January TR), and recalled the day in 1973 when she came to our New Jersey home between speaking engagements in Morris County. As an educational counselor I had arranged to have science-major students from several high schools come to Madison. Margaret conveyed the problems of feeding the world's hungry and the Institute's endeavor to create easily preserved nutrients. Margaret founded UROP, and if you contribute \$500 to the classroom renovation Project 2000, you will advance her last cause and receive a mounted chunk of the original 77 Mass. Ave. limestone steps.

A card from Margaret and Charles Price dated March 25, 1991, tells of their touring New Zealand's two major islands. "Did 150-foot bungee jumps today. See you in Santa Fe August 12-19." This refers to an opera visit by groups of enthusiasts, which Margaret used to arrange as a director of Opera Pacific in Costa Mesa, Calif. Last August Phil Hart arranged a special backstage tour for her group in the unique outdoor structure. Phil had a stroke in January and was unable to take the group tour to Europe. But he is up and about using a cane and is able to work again. Publication of his biography of conductor Fritz Reiner (July '88 Notes) is in contract negotiations.

Al Gray writes: "I spent 42 wonderful years in naval architecture—half with Gibbs & Cox designing Navy ships through World War II, and in peacetime, commercial cargo vessels and passenger liners. The most satisfying job was on designs and specifications for the S.S. *United States*. Built to be readily convertible to troop transporting her extraordinary power plant provided a then super-record speed of 35.6 knots. I was fortunate enough to design the aluminum superstructure, but later discovered one boo-boo. At the end of one tiring day during the vessel's trials, relaxing in a lounge, I was embarrassed to see our highballs dance to the edge of the table. The deck structure was picking up vibrations induced by the ship's propellers. Had I been a teetotaler, the defect might never have been discovered until drinking passengers complained." Al finished his career with 16 years of designing tankers, specialty carriers, marine drill rigs, and other unusual jobs, retiring in 1978. Modestly, he says that good design is often merely effort without serious errors, and in many instances the distinction between good and poor is very obscure.

A note from Crew Director Stu Schmill, '86, concerning the rowing newsletter *Squaring the Blade*, concludes: "Enjoyed meeting your class crew at 55th Reunion and hope to see you all at your 60th!" Yes, indeed, and at the rate we are *living*, Tom Johnson, Slim Beckwith, Bob Lutz, Rob Wead, Fred Noyes, and Al Whitcomb could also be there, and perhaps others who have never pulled a sweep since graduation. Please plan for it. Are all of our ex-oarsmen on the newsletter mailing list? If not, let me know. Stu says any rower alumnus can receive the mailings—free.

April 23: Our San Diego trip to see America's Cup elimination finals was a joy, except that one race was becalmed and cancelled at the third turn with Bill Koch, '62, well ahead of Conner (Koch won the next three with comfortable margins). Our efforts to visit classmates were only half successful. Dinny and Slim Beckwith entertained us at a supper, although he was recovering from a bad dose of shivers—a blood infection yet to be analyzed. . . . We missed Brent Lowe the times we called, but from an airport telephone we learned that he is up and out from 9 a.m. to 3:30 p.m. each weekday. By now a 16-year survivor of throat cancer, he sounds upbeat and talked with animation to me and Phoebe, whom he "met" for the first time. . . . I left a message on Philbrook Cushing's (Course XVI) answering machine and hope to have an item for next issue.—Frank L. Phillips, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745;

James F. Patterson, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

## 37

E.T. Herbig, Jr., retired as general sales manager from the E.F. Johnson Co. He and his wife, Elaine, have four children and four grandchildren. His main interests are local government and politics in general. About our 55th reunion, he wrote, "Have a good time! I will not be with you except in spirit. My days at MIT and my friends there are the happiest memories of my life." . . . C.C. Febiger sold his business, C.C. Febiger, Inc., on December 31, 1991, and is staying on a while as a consultant. He and his wife, Josefa, live in Essex, Mass., and his hobbies are tennis, boating, and cutting and splitting firewood.

Ed Peterson retired as president of Rolling Mill Engineers, Inc., of Douglasville, Pa. He is president of a farm corporation (beef and hay) and is also building and operating apartments (40 units so far). His main interest is music—he on violin and clarinet and Ruth on piano. He also plays tennis in his backyard court. . . . Bill Burnet writes, "Since I have post-polio syndrome, I cannot do much physically. We have a pool at our condo and get exercise swimming. Fortunately, Patty has trained me to enjoy reading. We celebrated our 50th anniversary last September. My roommate, Rutherford Harris, joined in the celebration as did Lloyd Bergeson, '38, both from Massachusetts."

Alice and Harry Metz live in Brisbee, Ariz. Harry retired from the Phelps Dodge Corp. and spends his time in travel and geneology. . . . Al Wynot moved in 1991 to New Pound Village in Walpole. His new address is 180 Main St., Suite 219, Walpole, MA 02081.

Art Zimmerman forwarded some newspaper clippings about Joe Keithley. One clipping reports that Joe is a new member of the National Academy of Engineering and was named for his "pioneering contributions to electric test and measurement instrumentation." Another clipping refers to a speech that Joe made to the Cleveland City Club Forum in which he stated that "the erosion of American leadership in important technologies and products is due to faulty management. We must become better managers in a world in which technology is becoming more important."

It is with sadness I report that William C. Wulbern died September 17, 1990; Bernhard Schondorff of Erkelenz, Germany, in March 1991; Edward A. Brittenham, Jr., of Bedford, N.H., on December 21, 1991; Kenneth B. Gair on January 17, 1992; and James W. Pearce on January 18, 1992. . . . Kenneth Gair had worked for Rockwell International, retiring in 1976. . . . James Pearce was a patent lawyer who loved his volunteer work with the Columbia Parkway Branch of the YMCA in Cincinnati. Our condolences go to the Wulbern, Schondorff, Brittenham, Gair and Pearce families.

The October issue of the *Review* will contain notes on our 55th Reunion. Look for it, and if you did not attend, please keep us informed as to your up-to-date activities.—Robert H. Thorson, secretary, 66 Swan Rd., Winchester, MA 01890

## 38

### 55th Reunion

Ed Hadley received word from Harold Strauss that the German firm Busak & Luyken, a leading supplier of hydraulic and pneumatic seals, has acquired Bill Shamban's Santa Monica company, which manufactures sealing systems. WS Shamban & Co. has plants in the U.S., England, Denmark, and Japan. For more than 30 years it has been a supplier to Busak. For the time being, both firms will retain their identities in the marketplace, for there is little overlap among their product lines. Both are significant suppliers to the aerospace, industrial machinery, and automotive industries.

Jean and Ed Hadley have just returned from a month on the road in March and April—visiting some of their children, celebrating their golden

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wedding anniversary with longtime friends, four days in Williamsburg, Va., then Epcot Center and Pompano Beach, returning via the west coast of Florida and visits with friends in Alabama. As Ed added: "It was a thoroughly enjoyable month without the pressures of tax consulting, Council on Aging, Pastoral Search Committee, driving for the elderly, and Meals on Wheels." Ed wants you to know that his eyes are OK—they just need to see more news from the rest of our classmates.

**Cliff Nelson** writes that his most recent trip was to Belize and Honduras. Beyond that, he and Jane are busy with local Maine organizations: the Gorham Land Trust, legislative chair of the Portland Chapter of AARP, and treasurer of the Gorham Historical Society. . . . **Bob Soloman** is semi-retired. He is adjunct professor in the Biology Department of the University of North Carolina at Wilmington and continues to serve his profession as physician in pathology around his state of North Carolina.

We just learned of the passing of **D. Sinclair Scott** in June 1991 in Buffalo. He had worked for Allegheny Ludlum Steel Corp. before his career at Scott Castings Corp., where he served many years as its president. —**Don Severance**, secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley**, assistant secretary, 50 Spofford Rd., Boxford, MA 01921

## 39

**Arther Vogeley's** career led to design and control instrumentation for humans to survive underwater and in space, thence into simulators and docking in space. Art formed companies that grew and are going public. Art did your adventures with ammonia to power the X-15 lead to your current hobby in organic gardening? . . . **Dick Leghorn** continues creative entrepreneurship. His recent projects include shepherding a research and development consortium and starting more companies in new technologies. A flat-screen TV, one that can be hung on the wall, may be in the offing. . . . **Bob Withington** and **Betsy** are fully occupied maintaining two big toys. One is their Cessna monoplane for which a standard engine overhaul was just completed. After the engine is in, Bob is to fly around at full throttle for the hour specified for "run-in." The other toy is a 45-foot sailboat anchored in Lake Washington in front of their home. Several classmates would encourage **Sid Silbur** and **Jean** to revisit the Northwest, because the last time they came, the **Jim Bartons**, **John Alexanders**, **Hans Babies** and **Seykotas** enjoyed a

cruise and other fun during a two-day '39er mini-reunion.

**Walt May** and **Hazel's** circle of new friends increases steadily as **Walt's** complete machine shop generates community goodwill and eternal backlog for parts to replace those worn out in aging lawnmowers, snowblowers, and garden tractors. **Walt** doesn't complain although his fly fishing reel must feel neglected! . . . **Howie Woodward's** career after graduate led him to Seattle where he worked for American Mail Lines until **Weyerhaeuser** encouraged him to come aboard and apply his talents to its paper mills in Massachusetts. **Howie** retired in Princeton, Mass., to enjoy 40 wooded acres, a large house, and organic gardening. The **Woodwards** were pleased to learn about the intermediate mini-reunion, planned for January 4-7, 1993 in Naples, Fla. . . . **Morrie Nicholson**, professor emeritus, and **Norma** are about to travel to Asheville, N.C., to visit MIT Theta Delta Chi fraternity brothers from '30s. This will be the seventh such event for **Sam Brown**, '34, **Gordon Burns**, '34, **Jim Eder**, '34, **Austin Cross**, '35, **Art Gilbert**, '35, **Bob Lindenmeyer**, '35, and **Phil Sellers**, '38. On return to St. Paul, **Morrie** will continue with an on-going cooperative project to improve the national exam for metallurgical engineers to become registered professional engineers.

**Irv Peskoe** and **Bea** are planning travel to Moscow to visit one of their three sons and help with some international consulting. . . . **Seymour Sheinkopf** and **Sylvia** sent a "get well" card to acknowledge my 76th birthday present (a pace-maker). The card reads: "Someday the aging process will be arrested. And considering what it is doing to our health, it should be!"

We are saddened by report of the death, on December 17, 1991, in Akron, Ohio, of **Robert Iredell**. **Bob's** career included project engineering and plants management in the tire industry. He was active in church, civic affairs, and Sigma Chi. —**Hal Seykota**, secretary 2853 Claremont Dr., Tacoma, WA 98407

## 40

A brief note from **Robert L. Hayes** states that he is celebrating his 50th wedding anniversary this year in Bedford, Va. . . . **Ted Gundlach** writes that he spent a week in February in the hospital with congestive heart failure, but he is okay now. He was glad to read **Walter Helmreich's** notes about his stay at MIT.

**Class President Norman Klivans** sent an update on the January 4-7, 1993, mini-reunion in Naples,

Fla. Those invited will be all members of the classes of 1939, 1940, and 1941; all Florida grads from 1935 to 1945; and all MIT graduates in southwest Florida. The reunion leadership includes 1940 classmates **Phil Stoddard**, **Doug Eckhardt**, **Spec Card**, and **Norm Klivans**, as well as **John Mullen**, '41, and **Bob Touzalin**, '39. More people are expected to be added to the group during the summer. Forty rooms have been reserved at the Naples Beach Hotel & Golf Club, and there are many other "more standard" facilities nearby. The hotel will be headquarters for two major evening events on Monday, January 4, and Wednesday, January 6. Tentative programs for daytime activities include golf, tennis, house tours, city tours, a tour of Corkscrew Swamp Sanctuary, a harbor cruise, deep-sea fishing, trips to the Collier Automotive Museum, the Teddy Bear Museum, Henry Ford and Thomas Edison homes, and PC instruction and orientation by IBM and Apple. It is hoped that **Paul** and **Priscilla Gray** will be our guests, and that the **Alumni/ae** Association president and key MIT staff members will also attend. By the time you see this column, those who have expressed interest should have received all the necessary registration information. By July 25, a decision will be made to go ahead, or, if there are not enough registrants, to cancel. On November 20, final details of program activities will be mailed to all registrants.

**Wesley Pendleton** wrote requesting more information about the reunion. As he spends winters in Zephyrhills, Fla., it would be an easy trip to Naples. He wrote an article on electrical insulation for the *Encyclopedia of Polymer Processing & Application*, a publication now in print by Pergamon Press. **Wes** commented on the good winter they had in Florida, and that they would return to Muskegon, Mich., in May.

I received a nice thank-you not from **Mrs. Martin (Davette) Abkowitz** in which she spoke of the fund at MIT that the family has established in **Marty's** memory. If any class member would like to contribute to the fund, it may be done through the **Alumni/ae** Office. . . . We recently learned of the death in June 1990 of **Thomas P. McConville** of Santa Maria, Calif. There is no further information.

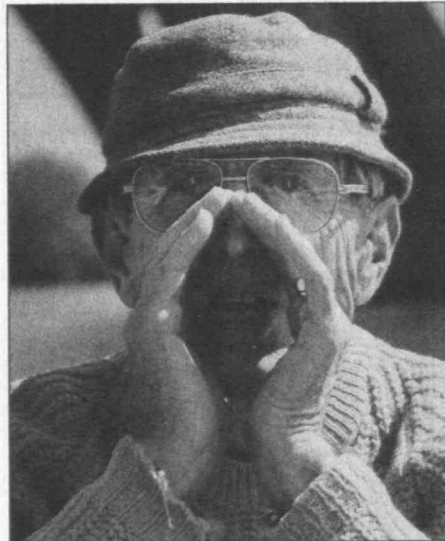
On January 26, 1992, **J. William Blattenberger** of Lawrenceville, N.J., passed away. The **Trenton (N.J.) Trentonian** wrote that he had been a "petroleum chemist for many years at Sun Oil Co. and then was assistant manager of research and development at Cities Service Oil Co. After retirement, he became business manager of Pendele Hill, the Quaker Study Center. He was a member of the **Radnor (Pa.) Friends Meeting**, a board member of the Mid-Atlantic region of the American Friends Service Committee and of the YMCA in Philadelphia and in Princeton, and was active in race relations and peace organizations. He was a hiker and member of several environmental and professional organizations.

As always, I look forward to hearing from you. Send your letters or telephone calls to—**Richard E. Gladstone**, secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

## 41

Washington area newspapers headlined the passing of a classmate on April 16, **Charles Butt**, *Championship-Winning Coach Dies . . . Butt Remembered for Service to Area Rowing . . . Gone, Butt Not Forgotten: W-L Crew Pioneer Eulogized With Wave of Admiration* . . . One report continued: "Nearly 500 members of Washington's rowing community joined family and friends at the Falls Church Presbyterian Church yesterday to bid farewell to 42-year Washington-Lee coach **Charlie Butt**, the National Rowing Hall of Fame inductee who led the sport's growth in the Washington area."

**Class** and crew mates **Bob (Wilson) Blake**, **Ed Hayes**, **Chet Hasert**, **Erling Hustvedt**, **Sterling Ivinson**, and your secretary attended the service and heard one of his championship oarsmen hail his coach, **Charlie**, as a "megaphone-wielding, blazing, flaming bonfire." Class members at the 50th



**Charlie Butt**, '41, was passionately involved in rowing, and devoted much of his life to the sport. He was instrumental in starting crew teams at numerous high schools and several colleges in the Washington, D.C./Virginia area. He died in April of leukemia.

To honor **Charlie** and his contagious enthusiasm, a group of fellow '41ers are endeavoring to raise funds for a fully equipped 8-person shell, which includes a set of oars and a microphone system. Nowadays, the outfit runs about \$20,000. The boat will be named the **Charles S. Butt, Jr.**, '41. Those wishing to contribute toward the shell may earmark donations to the **Alumni/ae** Fund.

T



\*reunion banquet will remember Charlie, as a substitute speaker, giving a modest, inspirational, off-the-cuff-remembrance summarizing his rowing career. Some of us will savor the memory of being a part of the two complete 8-oared crews he organized, earlier that day, for a row on the Charles.

A graduate of Course XVI at MIT, Charlie was active in 150-pound crew and rifle team during all four years. He captained the rifle team senior year, and was elected to the MIT Athletic Association and Scabbard and Blade. A graduate of Advanced ROTC (Ordinance), he was called to active duty in the Army Air Corps and served in the Design Branch, Aircraft Laboratory, at Wright Field Dayton, Ohio, with 12 of our classmates. Chet Hasert has chronicled their unique experience, "at the crest of the golden age of aviation," in the April *Technology Review* 1941 class notes. Charlie returned to civilian life in 1946 as a major, worked briefly for Culver Aircraft in Wichita, Kans, and joined the U.S. Navy Bureau of Aeronautics in Washington, D.C. Retiring in 1974, he built and sold 55 fiber-glass-skinned single, double, and pairs boats while continuing to coach local crews and serve on the board of directors of the U.S. Rowing Association. In addition to the many championships won by his crews, he received many personal honors from rowing and other organizations.

After being seriously ill since January, Charlie died of leukemia on April 16, at his home in McLean, Va. He is survived by his wife Millie, a son, four daughters, and three grandchildren. All class members extend their sympathy to his family.

His son, Charles S. III, is carrying on the family crew tradition by coaching at Harvard University. Charlie's memory will live on here through an annual scholarship fund at Washington and Lee High School. Contributions can be sent to the **Charlie Butt Memorial Scholarship Fund**, PO Box 11180 Arlington, VA 22210.

For Charlie's friends who want the memory of his enthusiasm to remain in the MIT Boat House, a group within our class is also establishing a fund to endow an MIT crew shell, to be named for Charles S. Butt, Jr., '41. Contributions to the Alumni/ae Fund can be designated for this purpose. A brief description of this memorial appears in a box on the opposite page.

We all congratulate **Stan Backer** for this month's one piece of happy news. Our classmate, professor emeritus of mechanical engineering and senior lecturer at MIT, was elected to the National Academy of Engineering, "for enhancing the understanding and engineering of fibrous materials to improve their performance in ocean and other engineering applications."—**Charles H. King, Jr.** secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

## 42

The report of our 50th Reunion and of Technology Day activities will be in the October notes, since I don't have the gift of prophecy and they haven't happened yet!

A newsy letter from **Adrian Marcuse**, who celebrated his 70th birthday by starting sailplane lessons sooner or later to lead to a glider pilot license. It's never too late for any of us to start something new. . . . **J.J. Quinn** works as a photojournalist for his local newspaper, the *Santa Monica Daily Outlook*, the California Yacht Club's monthly magazine, and for several other publications. His call as a ham is: KJ6HW if any of you operators want to get in touch with him. . . . **Ed Edmunds** "retired" in 1980 but since has gotten heavily into El Paso area commercial real estate and into a mold and die business as a partner of his eldest son. . . . Professor Douglas J. Forsyth of the MIT History Department has been appointed the Class of 1942 Career Development Professor. He received a PhD from Princeton in 1987 and has been on the MIT faculty since 1988.

Two obits: **Giulio Ascoli** in Urbana, Ill., and **Dick Gannon**, reported in a note from his wife, Esther, in Westborough, Mass.—**Ken Rossett**, secretary, 281 Martling Ave., Tarrytown, NY 10591

## 43

## 50th Reunion

A brief note has come from **Henry R. Brown** (Course VI) of Newport Beach, Calif., where he is president and owner of Detection Devices, Inc. Henry is busy answering questionnaires and writing letters to promote "replacement of our present batch of self-serving congressional 'lifers.'" He is also pursuing several patents and developments on tools and medical aids. For recreation, he enjoys the free skiing that California provides for septuagenarians.

For lack of other news, I report on Susan's and my April return to the scene of the Great South West California Florida Midtown Manhattan meeting in October 1989. Albq is little changed, except for the absence of the colorful hot-air balloons from the autumn ascension. Ottinger's Station is still in business, so we enjoyed an evening with Sue and **Harry Ottinger**. They continue in their customary activities of tennis and furniture building. During the course of the evening they pointed out the two-room adobe apartment where, immediately after retirement to Albq, they spent several months while learning and then using the techniques to build their present comfortable home in the foothills below Sandia Peak. Before parting, I gave Harry an unpurgated copy of the third installment from "The Over-the-Hill Gang in New Mexico," which had suffered severe truncation when it was published in class notes. He was appropriately grateful.

It is now less than one year until Reunion 50, with our first appearance in the red coats and the unveiling of our climactic class gift. The tension continues to mount.—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

## 44

Those of us in the MIT Club of Cape Cod are looking forward to our annual meeting at which Professor Ronald Latanision will be talking about "Crisis in American K-12 Education: What can be done about it?" We'll keep you posted.

On a sadder note, we just learned of the death in November 1991 of **Alessandro Morelli**. He was a graduate of Boston Latin School and earned an SB in electrical engineering at the Institute. He was a project engineer with Bell Aircraft from 1946-1952 when he left to join GTE Sylvania. There he was instrumental in the research, development, and production of many key radar and communications, command and control systems for various U.S. Defense Agencies. He attended the Sloan School and held many significant management positions at GTE. These included manager of the Radio Frequency Laboratory, development technical manager for the command and control system used in the Minuteman II intercontinental ballistic missile, and a similar position for the Tri-Services.

Alessandro was a senior member of the IEEE and was a registered professional engineer in Massachusetts. He retired from GTE in 1985. Our sympathy goes to his widow, Philomena.

That's all the news for now. We'd like to hear from all of you. Please do write.—Co-secretaries: **Andrew Corry**, P.O. Box 310, W. Hyannisport, MA 02672; **Louis Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

## 45

It is snowing here in New Castle, N.H., this Good Friday as Fran and I prepare for a three-week vacation in London and environs. Jean and Prexy **Chris Boland** will be joining us for about a week following their lengthy visit to Ireland—and summer will be about behind us as you read these notes.

By now you should be aware that we are organizing a Navy V-12 Reunion for June 1994; we are par-

ticularly interested in your reaction to this event and anxiously await your comments. Help!

**Ruthmary Jeffries** of Fairfax, Vt., better known to all of us as Jeff, writes: "After retiring from research at Dartmouth Medical School in 1984, I did quite a bit of travel overseas. I lived on the Caribbean Island of St. Eustatius working to help world peace and unity through the Baha'i Faith. My son-in-law is French and I went along on a three-week family reunion in France. I visited a daughter in New Zealand for three months. On the return I spent a month in the Cook Islands, half on a small remote one. I know how to travel at very little expense. Last summer I drove to the Southwest in my wee camper van visiting Chaco Canyon and the Hopi reservation and located some long-lost cousins in South Carolina. I have not been flying for years due to the high cost, but I still hold a commercial license. Now I have a small apartment over a garage, which I designed. It's on my daughter and son-in-law's property in rural Vermont. Quite a bit of time is spent helping out with my two small grandchildren and their horses and dogs. My daughter looks out for my home, mail, and cats when I travel."

Now why don't you sit down and write a similar note? Then I would have class notes for months to come! . . . **Jim Pickel**, a Gillette retiree, continues to teach calculus, physics, and chemistry at the Woodward School in Quincy, Mass.; his first student at the Institute is in the Class of '95. While Jim teaches, most of us would likely fail a quiz in 8:03, 5:01, or M-12. Agree?

We recently reported **Charlie Hart's** death and now we must report that Charlie's widow, Nancy, was killed in an automobile accident in Wayland, Mass., on March 12. Unfortunately, the memorial service was held on a stormy, snowy, March 19, which kept the Class of '45 attendance to a minimum. Nancy and Charlie never missed a '45 function. . . . **Robert W. Hallock**, former president of Hallock Chevrolet in Oyster Bay, Long Island, died February 12, 1991, and is survived by his widow, Evelyn. Bob was a Lehigh transfer and received his Course II degree in September 1946. I remember Bob as being Company I commander at one time or another. . . . One other death—**Keith W. Cramblet** of Santa Ana, Calif., on March 20, 1990.—**Cinton H. Springer**, secretary, Box 288, New Castle, NH 03854

## 46

Just a few days before Bettie and I were taking off for the "Silicon Valley" to join a reunion with a Lockheed group I had worked with for several years, the deadline (May 1) for this column came in the mail, forcing me to get it out fast.

The good news, which came in the same mail, was a nice long letter from **Pauline Teague** with a jolly photo of her and hubby John standing by the



boat harbor near their home in Oceanside, Calif. Turned out that she was taking a trip back east almost the same time we were going west! Anyhow, she's still in good spirits, which isn't quite true for her/our classmate, **Betty Stevens**, who lives nearby. The other of the XVI astronautical triumvirate, **Beverly Graham**, still lives on Shaw Island in the strait off Bellington, Wash., where she "plays computer games with her husband."



Pauline keeps busy as "acting" librarian and with projects at her church.

Other news coming through the pipeline included a snipping from "Jack" Norton, yet another XVI V-12er whom we rarely hear from. Jack is living happily in retirement in Greenville, S.C., after 30 years with General Electric. He enjoys life with wife Priscilla, traveling, golfing, visiting relatives, playing bridge, and reading. Jack invites all old classmates "traveling this way to stop in and visit." Hey, Jack, how 'bout signing up on the V-12 Reunion coming up in a couple of years? ... Cdr. Douglas Crinklaw, who made it through as a mechanical engineer now lives in Fallbrook, Calif., where he "continues to work with his avocado grove and travel when free from picking. Water shortage forced cutting 20 percent of my trees. Should recover in a couple of years if good weather prevails."

On the sad side, we've had word from Eugene Gehrig, one of our physic majors, an Evanston, Ill., lad who returned there to work in the Illinois Institute of Technology for many years. He informs us that he's been disabled since 1978 and hospitalized over two years. He hopes to go into business if he can get healthy again. Maybe you could send him a "get well" card at 1715 Chicago Ave., Evanston, IL 60201.

In the obituary category there are two. ... James W. Hawthorne worked for the Andover Group in Fairfield, Conn., until he passed away last September. He is survived by a son. ... Another casualty this past March was Emerson Newton, who had worked for Arthur D. Little as an electrochemist for 32 years before retiring in 1980. He was awarded the Apollo Achievement Award in recognition of special contributions to the field of science and invention. He was 76 and is survived by his wife, Harriet, who lives in Arlington, Mass., two daughters, and five grandchildren. With humble regrets, we wish them all well in years to come.—Jim Ray, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

## 47

Just two items this month. Carol Tucker Seward writes that Hurricane Bob (no comments about my name, please!) kept her and Bill from meeting Hester Stickley Virgin and her husband in Newport last summer; they did see them in Florida last winter. Winnie Bennett Corniea visits Carol once a year or so. Otherwise, Carol keeps busy with gardening, church activities, and family genealogy research. She also has three grandchildren (ages 10-15) next door to keep her busy.

Larry Varnerin retired this year and moved to Lake Winnepesaukee (Wolfeboro), N.H. He's taken up power boating and says it's really different from his professional life as chairman of the Electrical Engineering & Computer Science Department at Lehigh. He and wife Marie are enjoying it immensely, though. As of April, they were about to embark on a three-week trip to Ireland to celebrate their 40th wedding anniversary. Larry, Ann, and I plan two weeks in Ireland this fall.—R.E. "Bob" McBride, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

## 48

### 45th Reunion

Peter Saint Germain, Don Noble, Al Seville, Stan Abkowitz, Harold Ottobriani, Milton Slade, Bob Sandman, and yours truly met at the Faculty Club to learn about the Alumni/ae Association's planning and implementation of reunions for all classes. Eliza Dame heads up the Association's efforts and she has an excellent track record supporting our classmates both before and during our reunions.

Prof. Francis Ogilvie spoke to us about the Department of Ocean Engineering's plans to celebrate their 100th anniversary in 1993. In June 1993, during the Technology Day portion of our class's Reunion activities, the department will present speakers discussing their activities. When we were students, the department was named naval archi-

ture and marine engineering. The demand for off-shore drilling rigs and deep water submersibles was part of the reason for the name change. In addition the growth of ocean exploration led to changes in the department. By the time you read this, the success of America3 in the America's Cup race will be known. The department was very active in designing boats for Bill Koch.

At a prior planning meeting for our 45th Reunion, we decided to have the activities at a Nantucket hotel on Monday, Tuesday, and Wednesday (May 31st-June 2nd) before Technology Day activities on the MIT campus.

Milton Slade is chairman of the Reunion Committee. He and his wife, Jean, visited Nantucket to select a hotel. Milton recommended we stay at the Nantucket Inn and it was agreed to do this. Nantucket has a variety of historic homes, shopping, museums, nature walks, scenic tours, golf, tennis, and sailing for our enjoyment. There are beaches that stretch for miles for viewing or exercise.

Norm Kreisman in his capacity as advisor, international technology, to the U.S. Department of Energy serves on several committees to represent the department. One of these committees was negotiating with the Japanese to provide access for sale of a U.S.-made supercomputer in Japan. When negotiations stalled, the committee asked President Bush to apply some pressure on the Japanese Prime Minister during a meeting in San Francisco. After this was done, the Japanese spoke about accepting our request and paperwork was prepared to confirm the agreement. Norm reviewed the written exchanges. He found a clause the Japanese inserted which required an acceptance criteria based on a test that American manufacturers had demonstrated has very little relevance to the performance of the supercomputer. The Japanese were only going to agree to buy supercomputers that met the requirements of this test, and U.S. supercomputers would not meet this test.

Norm played a key role that helped assure success by the techniques he used to object to the clause. Combining technical expertise about the significance of the test and 11th hour timing, Norm was able to assist the American committee in obtaining the agreement with the clause deleted.

Brian Chetram, '94, received the Class of '48 Scholar Award from the 1948 Student Financial Aid Fund. Brian wrote to our class to express his thanks. He is from Hollis, N.Y., and is studying information technology, mathematics, and economics. Weight-lifting helps him relieve stress of school work. Having always wanted to attend MIT, Brian thanks our class for the financial support that is making his dream come true.

The other recipients of aid from our class are Hsin-Chien Tai, '93, from Danville, Va., and David Underwood, '93, from Piqua, Ohio.

Phil Lally is still working in the microwave tube business. He survived a plant closing, but continues at Teledyne MEC.

Donald Floyd died last year. Including service in World War II, he was in the Air Force for 23 years and retired in 1970. Then he was with the General Accounting Office and NATO. From 1979 to 1990 he was manager of congressional relations for Raytheon in Washington. He was a member of Theta Chi. On behalf of our classmates I extend our sympathy to his wife, Lynn, and her family.—Marty Billett, secretary and president, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

## 49

A news release forbidding me to breathe a word of its contents before 6:30 p.m. EST, Thursday, February 13, 1992, has reached me and, since it came in late April, I have scrupulously adhered to the required secrecy. This is by way of emphasizing that not all I give you in this column was datelined yesterday. In the release, Robert M. White, president of the National Academy of Engineering, announced the election of 79 engineers to membership in the Academy. "Election to the Academy is

among the highest professional distinctions accorded an engineer and honors those who have made important contributions to engineering theory and practice."

Gregory Lynes retired in July 1991 from GTE Government Systems Corp. in Westboro, Mass. At the time of his retirement, he was a member of the senior technical staff in the Strategic Systems Division. He is now narrating books on tape for the blind for the Perkins Institution Talking Books Library.

Bob Bigelow retired in April 1991 as VP of the New England Electric Co. after 41 years of service. He expects to spend much time at Woods Hole, Mass., catching up on his golf game, sailing, and fitting in some consulting work when it doesn't interfere with more important activities.

From the Worcester Telegram & Gazette of March 10 we learn that Ferdinand G. Mikel, 66, of Silver Spring, Md. died March 3, 1992, in Washington (D.C.) Medical Center after a battle with cancer. A native of Worcester, Mass., he had lived throughout most of his career in the Washington, D.C., area. He was an Army veteran of World War II and saw action in the Battle of the Bulge. He was a mechanical engineer with the Naval Air Systems Command, specializing in the development of gas turbine engines, and retired in 1980 to become a consultant. Among his relatives, he leaves his wife, Ulrika Mikel, to whom the class extends its deepest sympathies.

In a sadly belated report, Robert H. Ruth of Lodi, N.Y., died October 4, 1991. I have no information other than an entry in the Alumni/ae Register of 1989, which tells us that he was an electrical engineer working for RCA in Camden, N.J. The only survivor listed is his wife, Barbara, who should know that we are saddened by her loss.—Fletcher Eaton, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

## 50

GenRad, Inc., has inducted Malcolm C. Holtje, a resident of Concord, Mass., into its GenRad Fellows group. He joined General Radio in 1950 and is now director of GenRad's microelectronics operations. The fellows program recognizes senior staff members who demonstrate exceptional technical capabilities, technology leadership, and the highest level of sustained performance. Malcolm is the second GenRad employee to be honored. Congratulations. He is also the author of numerous articles in electronics industry technical journals. He is a senior member of the Institute of Electronics and Electrical Engineers and the International Society of Hybrid Microelectronics.

Richard W. Schweizer (Dick) has been notified that his oil spill reclamation invention has been approved for use by the MSRC (Marine Spill Reclamation C.). The units are being placed on ships to clean up oil spills. Eileen and Dick will celebrate 45 years of marriage and six children with a Mediterranean cruise this year. Dick lives in Texas. ... Lou Lehmann states that after 36 years with General Electric Lighting he has retired. Lou lives in Geneva, Ohio.

Dr. Peter Dayton from New Hampshire requests comments from class members about the alleged overcharges by MIT on federal funds. If you have any comments, please forward them to my attention and I will see that Peter and the Institute receive them.

Your correspondent has now fully retired from the business world and looks forward to golfing and fishing on Cape Cod. He also wishes that more classmates would communicate their retirement feelings, business activities, and just plain information about themselves. Dot and I celebrated our 40th wedding anniversary with our four children and their husbands and wives on a cruise in the Caribbean the first week of May. ... Please try to keep the information for this column coming. I now have additional time to coordinate the notes.—

John T. McKenna, secretary, 182 Midpine Rd., P.O. Box 376, Cummaquid, MA 02637



# 51

Retiring from Du Pont after 39 years of "very challenging, enjoyable work with a fine company," **John McCevo** now finds he is busier than ever. Only one of his seven children is still at home. He would like to find more time for sailing, tennis, and skiing. ... Enjoying retirement on the canals of Cape Coral, Fla., only a short distance from his daughter's home, **Curtis Barker** and his wife have travelled to the British Isles, the U.S. West Coast, and western Europe over the past three years. His only son will be married in May. Last fall, he had a great visit with **Bill Emery** and his wife, Betty. ... Our past class president, **Bill Maini**, was recently awarded the Harold Lobdell Distinguished Service Award by the Association of MIT Alumni and Alumnae. This award recognized his sustained alumni relations service to the Association and to the Institute. I feel there is no one more deserving of this award. Bill and his wife, Marie, recently accompanied Joanne and **Marv Grossman** on a trip to Israel.

Sadly, we received word of the passing of **Charles W. Ellis** in January. Charles had retired as VP of Boeing Helicopters. He entered MIT after serving in the U.S. Navy. Graduating with both SB and SM degrees, he joined the Kaman Aircraft Corp. and assisted in the development of the world's first drone helicopter. He joined the then Boeing Vertol Co. in 1965 and was named VP in 1973. He headed the Utility Tactical Air Support program. During his career, he was awarded six patents and served as a member of the Army Scientific Advisory Council and the National Research Council's Aeronautics and Space Engineering Board. Following his retirement in 1990, he became an adjunct professor at RPI teaching courses on helicopter design. Our condolences are extended to his wife, Madaleen, his two sons, and to his daughter. —**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

# 52

The face in the *Technique* photo is the sort seen on the business pages of the newspaper over the caption, "Named vice-president of. . .", and is a little incongruous among the baby faces we presented to the world then. The *Technique* caption is uniquely laconic—**Francis Van Wyk**, with a Westgate address and "XVIII Mathematics." No date of birth, no high school, no activities. The notification of his death is equally laconic: a "Return to sender—deceased" scrawled on the envelope of an MIT mailing. From the Westgate address in *Technique* we may guess he was married, and from the address to which the returned envelope was sent we know he lived in Wallingford, Pa. We do not even know when he died.

**Matthew Goodwin**, of Culver City, Calif., died July 26, 1990. He is survived by his wife, Arlene. ... **Roger E. Ladd** of Manchester, Mass., died January 9, 1992. He is survived by his wife. ... **Arthur F. Howard** of Sudbury, Mass., died March 17, 1992, after a long illness. He was president of a family business, Bemis Associates, a manufacturer of adhesives. Among other civic activities, he was a trustee of Hebron Academy. He is survived by his wife, Virginia, four sons, and nine grandchildren.

The American Society of Mechanical Engineers has named **Darrell Frohrib** a fellow. Darrell is a professor at the University of Minnesota, Minneapolis. —**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301

# 53

## 40th Reunion

Please send news for this column to: **Gilbert D. Gardner**, secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

# 54

**Dick Morley**, founder and CEO of Flavors Technology, Inc., in Amherst, N.H., was featured in the September 23, 1991, issue of *Design News* "Zen and the Art of Automation," describes Dick's unorthodox approach to computer integrated manufacturing. His Parallel Inference Machine (PIM), as I understand it, does an excellent job of bringing order out of chaos in the manufacturing process, and does it very fast.

I am very sorry to have to report the death, last February, of **Howard Babcock**. Howard had retired last year after 37 years of service with the directorate of science and technology in the Central Intelligence Agency. Our sincere sympathy goes to his family. —**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

# 55

**Sam Berliner** reports that he has been granted patents for an ultrasonic fluid processing method and for an ultrasonic fluid processing system. The method patent covers an improved technique for accelerating physical and chemical reactions in a flowing liquid system through the controlled application of high frequency sound at very high intensity. The system patent describes novel devices for controlling the flow and the ultrasonic energy. Besides MIT, Sam attended RPI and finally received a BS in science from Adelphi University. After several years at Aberdeen Proving Ground, he returned to Long Island, where he has spent most of his life, to join the Pall Corp. and later Heat Systems-Ultrasonics, Inc. He has had extensive professional involvement with the EPA and ASTM, and in 1990 began an independent business, consulting in ultrasonic liquid processing. Sam's older daughter is an executive starting up a new firm to manufacture and distribute high-tech garments for the clean room market, and his younger daughter writes data base programs for health care for Codman Systems. In his spare time, Sam is a writer and model railroader. You can contact him at P.O. Box 304, Sea Cliff, NY 11579 or call him at (516) 759-6001 or (516) 759-9375.

News is getting so scarce that my cosecretary has taken drastic steps to generate current events. **Doris** and **Roy Salzman** are in the process of relocating from Boston to the sunny south. Roy will be located at the Arthur D. Little Facility in the Washington, D.C. area. Doris will join him as soon as they sell their home in Carlisle. Roy can tell you more in next month's column. But if you don't send us news soon, you never know what we will do next! —Co-secretaries: **Roy M. Salzman**, 481 Curve St., Carlisle, MA 01741; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21042

# 56

**Richard Mateles** is president of the Candida Corp., a consulting firm in the areas of biotechnology, chemical technology, and business, located in Chicago. Richard worked in industry from 1980–1990 after teaching at the Hebrew University-Hadassah Medical School in Israel from 1968–1980. He and his wife, Roslyn (Simmons, '57), have three daughters: the older two are married and live in Israel. Richard and Roslyn recently went to Israel as their second daughter just gave birth to her first child, their second grandson. The youngest daughter is a junior at MIT studying environmental engineering.

**Harris Weinstein** is the chief counsel, Office of Thrift Supervision, U.S. Treasury Department, Washington, D.C. This office regulates the savings and loans banks. Harris manages a staff of 290, including 180 lawyers. The responsibilities of the Law Department include civil law enforcement, legal opinions, drafting regulations, and passing on mergers, acquisitions, closings, and securities filings of S&L's. Harris has written many papers on

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fiduciary responsibilities of officers and directors of depository institutions and professional responsibilities of lawyers to institutions. He is past president of the Alumni/ae Association and serves on the MIT Corporation. For recreation he plays tennis and collects Revolutionary War political posters. Harris's wife, Rosa, is the director of Himmelfarb Mobile University. This is a Jewish social service agency which conducts a program that uses the services of volunteers to bring educational programs to retirement and nursing homes. Daughter Teme is in her second year at Northwestern Law school in Chicago. She has two sons, 5 and 7 years old. Harris's oldest son Josh is a TV comedy writer; Jacob is a sophomore at Princeton University.

**Richard Merrill** of Baltimore, Md., died February 17, 1992, at home after a long illness. He was employed as a mechanical engineer at Westinghouse Electric in Baltimore. He is survived by his wife, Lucy W., of Baltimore, his mother, two sons, and a sister. . . . **Lester Y. Sen** of Honolulu, Hawaii, died on July 14, 1991. He was the executive VP of the Oahu Air Conditioning Co. Send news to—**Ralph A. Kohl**, co-secretary, 54 Bound Brook Rd., Newton, MA 02161

## 57

**Ed Roberts** has won the Association of American Publishers Award for the Outstanding Book of 1991 in the category of Business and Management for his book *Entrepreneurs in High Technology: Lessons from MIT and Beyond*, Oxford University Press. Congratulations, Ed. . . . **Larry Young** has moved to Houston to begin his astronaut training. He writes that children Eliot and Leslie are both MIT PhD candidates in astronomy, Robert does sound for laser shows, and Jody keeps the MBTA afloat.

**Gerald Murphy** is president of the Cook County Chamber of Commerce, Ill. . . . **Joel Schiffman** is active in the practice of orthopedic surgery in Alexandria, Va., and in sailing on Chesapeake Bay.—**John T. Christian**, secretary, 23 Fredana Rd., Waban, MA 02168, (617) 589-2060

## 58

### 35th Reunion

Please send news for this column to: **Mike Brose**, secretary, 1298 Hartford Tpke., #1-L, North Haven, CT 06473

## 59

Please send news for this column to: **Allan S. Bufferd**, secretary, Office of the Treasurer, MIT 238 Main St., Suite 200, Cambridge, MA 02142

## 60

We have another Class of '60 Fellow! Professor Thomas L. Magnanti, George Eastman Professor of Management Sciences and co-director of the Leaders for Manufacturing Program, has been given the second two-year, \$40,000 stipend. Professor Magnanti will be using the fellowship for advancing educational initiatives. I'll have more information on our latest fellow and the process for selecting fellows in the next issue of *Tech Review*.

**Robert Mullen** let us know that in January 1992 he received an ScD degree from University of New Haven where he is also an adjunct professor, teaching management information systems. Bob, who lives in Wallingford, Conn., was formerly director of MIS for Colt Firearms in Hartford. Congratulations, Bob, for showing us that '60 hasn't "hung it up" as far as academic achievements are concerned. Any other recent degree recipients out there?

In a recent press release, the Institute of Certified Management Accountants announced that **Beryl Denker**, treasurer of the Beltec Corp. in Scituate, Mass., has joined the CMA ranks. Beryl's certification follows a comprehensive examination and

demonstrated experience in many facets of accounting and financial management.

**Joe Verderber** writes that he has returned to the Boston area to become president of the TLSI Division of General Scanning, Inc., in Watertown. TLSI makes laser systems for micromachining. Joe also asks if anyone can help him replace his class ring, lost in a burglary (your class secretary's ring went the same route). Joe, and anybody else interested: **Jerry Kaiz** (of 1960 Plymouth Fury renown) replaced his lost ring with a graduate school ring which, though without class numerals, is a closer approximation to the 1960 style than the current undergraduate rings. Jerry told me that Balfour has destroyed the dies for the 1960 originals. Jerry said the replacement ring cost him about \$450 (I believe I paid \$35 for my 14 kt gold model in '59) and that he ordered it through the Alumni/ae Office.

I received an announcement that **Mark Pratt** has received an Exxon Chemical president's Award for Innovation in New Business Development. Mark is venture executive of the Separations Venture, seeking new business for Exxon Chemical by selling systems and services to solve difficult problems in wastewater and air pollution. Mark and his wife, Susie, live in New Canaan, Conn. They have two sons and a daughter, all of whom, Mark is happy to report, are gainfully employed.

By now you've all read and reacted to the Rodriguez/O'Connor/Blatchley letter announcing the mini-reunion on Cape Cod and asking you to support our depleted class treasury with a \$10 dues payment. I hope that some of you were able to make the mini-reunion and that others might consider sponsoring such gatherings in other areas—New York, Los Angeles, or D.C., perhaps. Jorge and I talked about the need for dues. It costs about \$500 to make a class mailing and as the R/O/B letter notes, our class treasury is in woeful shape. So, if you haven't already heeded the plea, please consider helping the class by sending a few bucks to Bill Blatchley at 29 Pine Ridge Rd., Reading, MA 01864.—**Frank A. Tapparo**, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

## 61

Please send news for this column to: **Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167

## 62

I'm sure it's not news to most sailing fans, but classmate **Bill Koch** and his America<sup>3</sup> team has won the America's Cup. Bill's America<sup>3</sup> syndicate has developed high tech sails which are a composite of carbon fiber, liquid crystal and a very high-density, high molecular weight polymer (see February/March issue, MIT p. 4-9). Bill has offered the new material to the U.S. Olympic sailing team for their use at the Summer Games in Barcelona.

**John Prussing** has forwarded a letter from De Zhao Yu, one of our MIT Class of 1962 Scholarship winners. De Zhao wishes to thank the Class for the opportunity to continue to study computer science at MIT, and assures us that his academic effort will be a credit to our Class. He is active as a student leader as publicity director for the Lecture Series Committee, member of the Chinese Student Club, and plays several intramural sports including tennis, softball, volleyball, and table tennis. De Zhao was born in China, but now lives in New York City.

Other recipients of our Class of 1962 scholarships include Mary Tschoi, a junior biology major, and Alice Gilchrist, a sophomore math major. Mary was born in Seoul, Korea, but grew up in Queens, N.Y. She will probably follow a career in medicine. Alice is from Boothbay Harbor, Maine, and is considering teaching as a career. Both are active in a variety of extracurricular activities. One of last year's Class of 1962 Scholars, Jason DeSantis, is continuing his graduate work at MIT in the Department of Materials Science (good old Course III).

**F. Kaye Porter** included some information on her

AMITA (Association of MIT Alumnae) membership form that I now pass along to you. Kaye's husband retired this spring, and she quit her job temporarily so that they can tour the United States in a fifth wheel trailer. Kaye plans to start a consulting firm, Porter-Gable Associates, when they return from their tour of the country. Kaye's son, Scott Porter, is ready to go with PC software utilities.

Some sad tidings from Hermiston, Ore., where classmate **Keihachiro Moriyasu** died on January 4, 1992, from cancer. His sister, Janet Tucker, passed along the news that Dr. Moriyasu last worked for McDonald-Douglas in California prior to his death. We are always saddened to learn of the loss of one of our classmates and extend our sympathy to his family and friends.

My own professional doings have led me to the presidency of the Mineral Economics and Management Society (MEMS) for 1992-93. MEMS is a professional society whose members are drawn from industry, government, and academia worldwide, with particular interest in the economics and management of energy, metals, and non-metallic mineral resources. We held our first annual meeting in Washington, D.C., in March, 1992, and will meet again next February in Reno, Nev., following the annual meeting of the Society for Mining, Metallurgy, and Exploration (SME of AIME). You might find our newsletter, MEMSNET, on the internet/bitnet/telnet system. Please drop me a line with news of your family, accomplishments and good (or sad) tidings to be shared with our classmates.—**Hank McCarl**, secretary, P.O. Box 352, Birmingham, AL 35201-0352

## 63

### 30th Reunion

I have one personally-written note and a pat on some backs to pass on. The note is from **Allen Tobin**, who reports being professor of biology at UCLA, and chair of their interdepartmental program in neurosciences. He is also scientific director of a foundation that focuses on the causes of Huntington's disease.

You may recall that there is a Class of '63 Phi Delta Theta Scholarship Fund, administered by the Financial Aid Office. James Williams, last year's recipient, graduated a year ago. The new scholar is Lawrence Foley of East Northport, N.Y., in the Department of Materials Science and Engineering. Mr Foley is avidly involved in intramural sports and treasurer of the fraternity. Despite his many activities, he maintains an excellent "cume." Congratulations to members of PDT who have increased the fund by \$9.5K in just the past year. Goodbye for now and WRITE!—**Phil Marcus**, secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (410)-750-0184, Compuserve 72047.333, Internet: 72047.333@compuserve.com.

## 64

Louise and I returned from our spring golfing adventure on the Kona Coast of Hawaii to find a giant-sized box of mail waiting for us. Lots of bills, bank statements, etc.—plus a very thin letter from the Institute containing this month's input to the column. Those of you who remember the agonies of the high school senior year "thin letter" syndrome can imagine how I felt. Take pity! Send some news in with your Fund contribution.

The one item in the thin envelope was some good news. From the March 9 society page of the *New York Times*, we learn that **Robert Factor** married Elizabeth Nan Shapoor at the couple's New York home. Robert is vice-president of Howard Davidowitz and Associates, a New York financial consulting concern.—**Joe Kasper**, secretary, RR 2, Box 4, Norwich, VT 05055

## 65

The National Academy of Engineering announced the election recently of 70 new members, including



**Charles Seitz**, professor of computer science at the California Institute of Technology. Professor Seitz was honored for his pioneering contributions to the design of asynchronous and concurrent computer systems.

**Bill Schreiber** was recently appointed VP and director of fragrance chemical synthesis research at International Flavors and Fragrances. Bill's group does the hard core organic chemistry research to extend the fragrance palette for IFF. Bill reports that son Sean has now finished college and actually has a job (we can affirm that some degree of independence is possible among children over the age of 21). When he's not adding to our synthetic fragrances, Bill plays baritone horn in the local concert band. He says he began playing again about 10 years ago and enjoys the activity.

**George Moyer**, another member of the old Jay Forrester class at MIT, has been living in Los Angeles for the last seven years involved in Citicorp's aircraft leasing business. George joined Citicorp in 1971 after a brief stint at Boeing. George reports that daughter Ann, now age 17, is off looking at colleges, and his son Dan, age 15, is eagerly awaiting his driver's license. I didn't have the heart to tell George that both my girls succeeded in totalling a car in their first year of driving. George and his wife Martha are celebrating their 25th wedding anniversary this year.

**Vinod Jhunjhunwala** reports that the children are now through high school and that he has moved his business to Connecticut.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

## 66

**Thomas O. Jones** has added professor at Harvard Business School to his many other endeavors. . . . **Stuart E. Madnick** is John Norris Maquire Professor of Information Technology and Leaders for Manufacturing at MIT's own Sloan School of Management. . . . **Michael Oppenheimer**, cited as "one of the nation's most renowned environmental scientists," delivered the Muskie Lecture at Bates College this spring: "Global Warming, Technology, and Politics: Nexus for the 21st Century." He is senior scientist at the Environmental Defense Fund in New York where he directs studies of the environmental consequences of atmospheric change. The article mentions that he is a frequent guest on a variety of television programs and a prolific author. Now if you could all be a little more *prolific* authors of news items, I'd have a lot more to write.—**Eleanor Klepser**, secretary, 84 Northledge Dr., Snyder, NY 14226

## 67

Attentive readers of these class notes know that for many years **Mike Zuteck** has been at technology's cutting edge in promoting wind as an alternate source of energy. In a recent Department of Energy competitive procurement, Mike was teamed with five of eight winners for projects to improve turbines at existing wind farms. One of these was entitled "Hawaii Zuteck Rotor Project" and involved fitting flap-controlled blades to the 142-foot diameter Westinghouse wind turbines at Hawaiian Electric's Kahuku wind park. It's a potential follow-on to a 160-foot one-piece bonded rotor with flaps, which will be unique within current design practice. It's a great opportunity for Mike to finally test ideas that he has believed in for several years.

**Ray Ferrara**'s current work at DEC is on a large-scale "information utility" project designed to bring the information resources of the extended enterprise to the individual's desktop. . . . In January, **Dave Garbin** received the general manager's Award for Excellence from MITRE's Center for Civil Systems. Dave's award-winning work measures the price performance of AT&T and US Sprint, the two vendors on a major government program (FTS2000). Using a "market basket" of telecommunications services, David's program

compares FTS2000 prices to an index of prices for publicly available telecommunications services, computed every six months. Part of the difficulty of developing the index was finding one beneficial to the government that could also be agreed upon by highly competitive Sprint and AT&T, both of whom feel the impact of the results of the indexing. Dave's success is demonstrated by the fact that \$50 million is expected to be saved by the government as a result of the new system's implementation.

**Dana Ballard** is a professor of computer science at the University of Rochester and the principal investigator for a "virtual reality" laboratory being established at the University's Center for Visual Science. Eye-hand coordination is the focus of the research. The project is being funded with a three-year grant from the National Institutes of Health. . . .

**Lin Olsen** works for DEC and lives in Framingham, Mass. She writes that her life is good, and that her 12- and 17-year-old daughters are amazing. She still loves engineering-oriented work on computers. . . . **Tom Baer** is a senior research associate in the Experimental Psychology Department at Cambridge University (in the other Cambridge). He remarried four years ago, and last year he and his wife adopted a wonderful baby girl in Sri Lanka. . . . **Ken Ogan** joined Hitachi Instruments in 1989 as a principal scientist and senior product marketing manager. Prior to Hitachi, Ken was with The Perkin Elmer Corp. in Connecticut.

**Leslie** and **Andrew Skibo**, and their four children (Zak-16, Nick-13, Jedd-11, and Bryn-7) recently moved back east to the Philadelphia area after living nine years in the San Francisco area. The move resulted from Andrew taking over international marketing responsibilities for Life Sciences International, one of the largest firms providing engineering, construction, and validation services to the pharmaceutical and biopharmaceutical industry. Since he retains responsibility for the West Coast office, heavy travel is part of the job. He also has been busy renovating a circa 1734 farm house in the West Chester, Pa., area. Four years as House Manager at SAE at MIT, in an ancient brownstone, must have given him an incurable desire for never-ending maintenance. . . . **Charlie Holdaway** is a principal engineer at IVAC Corp., a manufacturer of electronic intravenous pumps and other medical instruments. He writes that he's still playing music (and even getting paid to do it) and has recently started performing as a stage and parlor magician. The latter skill is especially useful in electronic engineering! His son and daughter are now 4 and 6, respectively.

From time to time we list the names of some classmates for whom MIT does not have current addresses. Please contact me if you know the whereabouts of any of the following individuals: **Ernest Anderson**, **Edward Becker**, **Richard Bronowitz**, **Nathan Curland**, **Richard Ely**, **Richard Gauthier**, **David Hankin**, **Mohammad Llahi**, **James Lapis**, **Paul Martin**, **William Peitsch**, **Thomas Roddick**, **Silva Beauperthuy**, **George Stiny**, and **Lenard Weinstein**. Thanks for your help.—**Sharlotte** and **Jim Swanson**, co-secretaries, 878 Hoffman Terrace, Los Altos, CA 94024

## 68

### 25th Reunion

As you can see, this is the issue of *Technology Review* in which the Class of '68 officially becomes the 25th Reunion class. Reunion Chair **Ken Morse** sends the following bulletin: "Our 25th Reunion is Thursday through Sunday, June 3-6, 1993, about one year away, so save the date. We are actively seeking recommendations from classmates on entertainment and venues. Among the possibilities are the Pops, a Harbor tour and clambake, a dinner-dance at one of the Boston area museums, lectures, cocktail parties, you name it. High on our list is a suitable class hack. We have a tradition to uphold and impressive predecessors to emulate.

"Please fax or phone me with your most creative suggestions (anonymously if you prefer). Most important is that you plan to join us for the best possible reunion.

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"If the recession has hit you hard and you are short of travel funds, help is available. A number of classmates have contributed a basketful of frequent flyer coupons. If a free ride will enable you to attend, please let us know and we'll send you a ticket. The more the merrier."

Reunion mail can go to: **Ken Morse**, reunion chairman, 65 Greylock Rd., Wellesley Hills, MA 02181; work phone: (617) 497-9010, ext. 306 (24-hour voice mail); fax (617) 497-7806. **Gail and Mike Marcus**, secretaries, were due back from Japan in May: 8026 Cypress Grove Ln., Cabin John, MD 20818.

## 69

Due to a month's hiatus in these notes, which I will conveniently blame on my basement CF experiments, an extra large dose of news this time. A sad "first," however, the need to report the deaths of two classmates in one column. **Willard J. Basner, Jr.**, of Franklin, Mass., died January 24, 1992, in the Milford-Whitinsville Regional Hospital after being stricken at home. He received an SB in aero-astronaut engineering from MIT and a master's degree in aero-astronaut from the University of Michigan in 1970. At the time of his death he was an engineer for Stone & Webster of Boston, previously having worked for General Electric in King of Prussia, Pa., and Codex of Milton, Mass. Willard is survived by his wife, Margaret Basner, a son, and two daughters. His obituary in a local paper notes that this former Eagle Scout was a member of the Bill Koch Skeet League of Massachusetts, the Sierra Club, and several other environmental groups. He was also active in the Democratic Party. . . . I have no information on the death of **Edward A. Parks** of Big Flats, N.Y., other than official confirmation that he died in 1991.

Now on to the living. **James A. Smith** writes that he has "happily relocated Journal Graphics to Den-

ver, where I grew up in the 1950s. Home at last!" . . . Lt. Col. **George C. Slusher** says that he plans to retire from the Air Force in April 1993 after 22 years of service. He writes, "I'm considering moving from California to either southern Oregon or the Shenandoah Valley of Virginia, near where I grew up." . . . **Joel Morgenstern** is a family physician in Shoreham, N.Y. He and his wife Kathy have two kids, Kevin (10) and Amy (7).

Professor **Joseph S. Verducci** will be visiting Australia National University in Canberra, February to June 1993. He'll be going with his wife, Barbara, and daughters Madeline and Ann. After that he will be visiting at Queensland Institute of Technology in Brisbane. . . . **Richard G. Marcus** is now president and COO of American Biltrite, Inc., in Wellesley Hills, Mass. . . . **Michael J. Underhill** has moved to Phoenix and is now the director of the School of Architecture at Arizona State University. . . . **Richard D. Preston** is living in La Conner, Wash. doing carpentry. He just finished building a winery in Portland, Ore. . . . **Robert A. Schaeffer** writes that he is "busy travelling the country training peace and environmental groups in political communication skills and selling my book *Winning Local and State Elections*. Most recently I travelled to South Carolina and Georgia to help counter the consequences of unfettered technology and the Cold War arms race at the Savannah River nuclear weapons plant." . . . **Paul E. DeCoriolis** has taken a position as principal electronic design engineer with InControl, a venture capital-funded medical electronics start-up company. He and his wife, Janet, moved from Miami where he had been with Condis Corp. for eight years.

**William E. Brower, Jr.**, has been appointed associate dean for research at the College of Engineering at Marquette University in Wisconsin. . . . **Denis A. Bovin** is vice-chairman of investment banking at Bear, Stearns & Co. in New York. . . . **Robert M. Metcalfe** says in regard to his appointment to publisher and CEO of InfoWorld Publish-

ing Corp. (reported in the July issue): "People may ask, 'What's an engineer doing as a newspaper publisher?' Listening, figuring, and explaining are what I like to do. I have long been in the business of communicating *through* and *among* computers; now I'm in the business of communicating *about* computers."

Now that I have finished this freebie communication, it's back to the basement quest for excess heat from a \$10,000 nuclear reactor.—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

## 70

**John Stempeck** writes us that he has been doing strategy consulting with Braxton Associates for the last seven years. He says, "The work is good, but the trips are getting longer and longer. This particularly grueling on my wife and four sons. Fortunately, I am able to keep in shape for these trips by beating Bob Ferrara, '67, on a regular basis in racquetball."

That is it for this month; we need more correspondence!—**Greg and Karen Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

## 71

**Daniel Kelley** has recently become VP of Private Sector Initiatives Foundation, which provides technical and financial assistance to developing countries, privatization of state-run entities, private schools, and private health care. . . . **Louise Grochow, M.D.**, is associate professor of oncology and a joint appointment in the department of pharmacology, Johns Hopkins University School of Medicine. Married to Jerry Grochow for 22 years, she has two children—Rebecca, 12, and Joshua, 8.

If it weren't for ProNet, I wouldn't have this job. I applied for a position and didn't hear anything. At the same time my resume came up on a ProNet search for that job. The search resulted in an interview for me... and the job I really wanted. ProNet made the difference.  
Mark Peters '87  
West Palm Beach, FL

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It's easy and it's confidential. For more information write: MIT ProNet, Registration Department, MIT Alumni Association, 77 Massachusetts Avenue, Cambridge, MA 02139.

# MIT ProNet... it works.



Dr. **Mark H. Alfred** is now collecting and dealing in Chinese and Japanese antiques. His company is called *Through the Centuries*. Anyone interested in buying or selling should contact him in Penlllyn, Pa. . . . **Pamela Reekes McKirdy** has moved to Burlington, N.C., with her husband, 11-year-old son, and 3-year-old daughter. She is working on a PhD dissertation and would like to hear from other MIT alumnae in the area.

**Sekazi Mtingwa** was appointed to professor and chair, Department of Physics, North Carolina A&T State University, Greensboro, N.C. In May 1992, he will begin a two-year term as president of the National Society of Black Physicists. In November 1991, he and his wife, W. Estella Johnson, traveled to Ghana, where he was the 1991 DuBois-Padmore-Nkrumah lecturer. This annual lectureship is sponsored by the WEB DuBois Center, which is run by the National Commission on Culture. Over a two-week period, they traveled throughout Ghana, where he gave lectures at universities, secondary schools, and the DuBois Center on a variety of topics relative to the scientific and technological development of Africa.

**Hugh H. Sprunt, CPA**, has formed a new service called *Advantax*. He has a 900 number over which he gives personal tax advice for a fee per minute. After leaving MIT, Hugh was a commissioned officer from 1972 to 1975 aboard three research ships as senior watch officer and chief diver. He received an MBA and J.D. from Stanford. He was a tax partner with a big-six firm and is currently active as a speaker at financial planning seminars. He is writing an income-tax reference work and is serving as a consultant to other CPAs and selective clients.

Please send me your news.—**R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834-1808

## 72

As I write it's before, and as you read it's after, so I guess the best thing to say is, "Gosh, we sure must have had a great reunion, and I must have enjoyed seeing you all again."

**Dave Davis** writes, "I'm still serving in the Air Force and doing flight simulator development here in southwest Oklahoma. I train student pilots to fly C141 jet transports and travel quite often to meet with our training contractors. It's something different every day. The folks in this part of the world are real friendly." . . . **Allan Kirkpatrick** was recently promoted to full professor in the Mechanical Engineering Department at Colorado State and does research on energy efficient buildings. . . . **William Gahl** is now chief of the Human Genetics Branch at NICHD, studying inborn errors of metabolism and "looking for good fellowship candidates."

**Thomas Eager**, professor of metallurgy at the Institute, presented the Adams lecture at the American Welding Society convention in March. The lectureship is the highest scientific honor given by the society. . . . **Brad Billetdeaux** writes, "It's been interesting to reminisce with classmates and alumni/ae from other years as I've been participating as part of the MIT Alumni/ae Fund Visit Program and the Class Gift Committee.—**Dick Fletcher**, co-secretary, 135 West St., Braintree, MA 02184

## 73

### 20th Reunion

The last time I saw **Steve Altchuler**, it was on the front steps of the Student Center, late in our senior year, and he was worrying about medical school admission. Since then, as a letter relates, he has received both an MD and PhD (the latter in Course XX), followed by work at the Johnson Space Center. The "interesting fringe benefits" there were 70 minutes of weightlessness in a KC-135 over the Gulf of Mexico. After a few years of that life, he returned to medical school, took a liking to psychiatry, and headed to the frozen northlands of Minnesota. Steve is now on the staff of the Mayo Clinic, specializing in sleep disorders. He and his wife, Debra, have two children, but the letter did not mention their opinions on the case of *Texas v. Minnesota*.

**Ann McBain Ezzell** is still pursuing a sign-language degree at Madonna University and traveling as a fencing official. Her most recent trip was to Sweden, where she combined visits to two schools for the deaf with a fencing tournament in Goteborg. She is also tutoring math and "trying desperately to remember integration by parts." (Start with the baritone. . .)

At home, JR has started Boy Scouting with a full-body case of poison ivy. Eric starts at Radford University in the fall, and Ruth and I start dreaming of a quieter house. Write!—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

## 74

Please send news for this column to: **Lionel Goulet**, secretary, 115 Albemarle Rd., Waltham, MA 02154-8133

## 75

**Gary N. Fostel** writes, "Jenni, '76, finally finished at Duke in '91 (biochem) and 'Dr. Jenni' got a research job at Abbott Labs. I resigned from CompSci at NCSU, and we all moved to Kenosha, Wisc. Our daughters, Robin and Lindsey, are now 13 and 11 years old—no 'Tute teens here 'cause their passions are music and art (phew!)". . . . And this from **Stan R. Roth**: "We have just had our second child, again a girl. She is Kimberly Diane Roth." . . .

**Joseph A. Martore** is president, Management Strategies, Inc., specializing in management and operational performance improvement programs, and energy policies and programs for the federal government and industry.

From the *Messenger-Press* of Allentown, N.J., I have learned that, earlier this year, the New Jersey State Bar Foundation sponsored a free seminar on state and federal income tax at which **Martin Davidoff** was a speaker, discussing home mortgage interest rules. . . . I received a letter from **Kay Anderson Sieverding**, who lives in Steamboat Springs, Colo., with husband, David, and sons, Eddie (6) and Tom (2). She and David operate a slide imaging service out of the 2,400-square-foot basement of their home. It sounds like quite the operation, and their customers include MIT, Harvard Medical School, Sloan-Kettering, Nestle, and Exxon. Kay has been in touch with **Lydia Talmers**. Lydia is involved with international mining exploration out of Irvine, Tex. She is expecting her first child and, according to Kay, "Lydia reports that she is now blond and dresses to kill, Texas style." Sounds like our Lydia.

And finally, how many of you know of the Class of 1975 Scholarship Fund? Well, I am your class secretary, and it was news to me. Anyway, two students receive Class of '75 scholarships for the academic year 1991-92. They were Scott Winham, a junior in civil engineering from Fair Haven, Vt., and Maya Trotz, a sophomore in chemical engineering from Teaneck, N.J. The recipients, through the MIT Financial Aid Office, send their sincere thanks to all of you who have contributed to the fund.

Keep writing.—**Jennifer Gordon**, secretary, 18 Montgomery Pl., Brooklyn, NY 11215

## 76

From **Vivian Ho Wu**: "I married Fred Wu, '73. We both work for IBM. Fred is a manager in Yorktown Research, and I am a program manager in HQ marketing. We have a boy, Brian, 8, and a girl, Jessica, 4. Would love to get in touch with old friends." . . . **Mark Sneeringer** has joined the GE Research and Development Center as manager of Remediation Vendor Development Programs. Mark has worked for GE since he got a PhD in geochemistry from the 'Tute in 1982—first for GE Superabrasives in Worthington, Ohio, and then in GE's Irish facility where he held several positions. Mark and wife Maggie

have two daughters and live in Niskayuna, N.Y.

**Fred Knoll** made the *Washington Post* March 9 with a full-page spread. Fred engineered the takeover of C3, Inc., a software contractor to the U.S. government, about three years ago. He has also picked up another firm, Telos, Inc., a California-based software and computer service firm that also has a large government software contracting division. Fred, upon graduation, embarked on a career in finance, of which the above is the latest of a series of acquisitions.

The above represents all the news I have. So, we must ask, where are you now? (Any details, including current addresses, phone and fax numbers, would be gratefully appreciated.) Where are **Bruce Deffenbough**, **Robert Diedricks**, **William Diffin**, **Tevin Dray**, **Lisa Dron**, **Alan Dubin**, **Gary Eadens**, **David Eater**, **Donald Erickson**, **Jill Feblowitz**, **Jonathan Feldman**, **Guy Ferraiolo**, **John Fine**, **Charles Finkelstein**, **Brian Fischer**? There will be more names next month.

As for your secretary, I continue to advance in the "priesthood" of high technology. There are now so many products, both hardware and software, that we appear to have evolved a select group of people who know about and understand them. From my perspective as a vendor, this is very good—with mystery comes high prices. This is quite unlike the world of commodities.

Please write, fax, or call. We urgently need news.—**Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, fax (516) 295-3230

## 77

I have news of four classmates from Alumni/ae Fund reply cards. Perhaps next month, news from reunion activities will be available. Starting in Massachusetts: **Sue Stewart** is back as a postdoc in biology at MIT after a postdoc at Yale. She and her husband, Joe Jones, '75, have a 1-year-old daughter, Kate. They live in Acton. . . . **Howard Boles** is still enjoying working as a senior software engineer at Kronos, Inc., in Waltham. He writes, "The deadlines can be intense, but MIT prepared us to expect things like that! On the musical front, I returned to the 'Tute last December to accompany a staged reading of an original play written by MIT Humanities Professor **Alan Brody**. The play, 'The Company of Angels,' tells the true story of the revival of the Yiddish Theater in eastern Europe after the Holocaust. It was a deeply moving experience." He reports that his wife, Lisa, and daughter, Bethany, who will be entering first grade this fall, are doing well.

Moving to Ohio, we find **Charles Libicki** with four children all at the Columbus Torah Academy; his son Daniel will be starting high school there this fall. Charles has bought into the entrepreneurial firm for which he has been working. His wife, Penny, is completing a degree at Ohio State. . . . **Nina Cahan** sent word from Cappel, Tex., that she would not be able to attend the reunion unless she got a partner in her private practice of family medicine with obstetrics. She is the only family practitioner at her hospital who does obstetrics, and it is unreasonable to expect babies to honor reunion dates! She is incorporating into her practice her new knowledge about herbs, acupuncture, homeopathy, etc., and she is actively seeking someone to join her in her practice just outside of Dallas.

As for myself, here in northern Virginia, I am learning not to overextend myself quite so much in PTA commitments. Paul and I continue to marvel at the growth in maturity and curiosity of our wonderful brood—we have a budding scientist, a future engineer, and a social butterfly who wants to be a construction worker! We also have acquired a dwarf Siberian hamster who is much loved and appreciated by four-fifths of the family. Please write me (or my successor, if that is someone other than me) a letter, especially if we have not heard from you in a long time, and/or if you were unable to get to the reunion. It's so great to hear from our old friends!—**Ninamaria Maragioglio**, secretary,



## 78 15th Reunion

We have news this issue from numerous press clippings and press releases: **Yvonne Tsai** practices general and pediatric ophthalmology in Salem, N.H. She attended Cornell Medical College after the 'Tute. She was recently elected to the board of directors of Blue Cross/Blue Shield of New Hampshire. Yvonne is a fellow of the American Academy of Ophthalmology. She lives in Atkinson, N.H. ... Another doctor, **Jim Roth** was elected to fellowship in the American College of Cardiology. He attended University of Pennsylvania School of Medicine, and is currently assistant professor of medicine at Albert Einstein College of Medicine and a clinical electrophysiologist at Montefiore Medical Center in the Bronx. Jim lives in Hastings on Hudson, N.Y. ... **Thomas D.Y. Chung**, a doctor of the PhD variety, is currently at Bristol-Myers Squibb as a research investigator in the Department of Virology. He and wife Barbara live in Lambertville, N.J., home of the Shad Festival and noted for its artists.

**Regina Murphy**, a Course X doctor, sent along



Kevin Joseph Etzel

wife Diane Curtis's is. (She's probably got a little more upheaval than we do. At least our kids came

seven months apart.) Regina writes, "I am still an assistant professor at the University of Wisconsin-Madison in chemical engineering. I'm taking most of the summer off to take care of the babies, but will be back in the fall to get back on the tenure track—I still have three more years to go, and I'm doing biomedical research. My husband, Mark Etzel, is an assistant professor in food science with a joint appointment in chemical engineering. We both enjoy our jobs and Madison, but miss Boston. Since my family is there we get back a few times a year."

**Robin Newmark**, a marine geophysics PhD from Columbia University was featured in a Lawrence Livermore Labs publication featuring Women in Science and Engineering. Robin has been at Lawrence Livermore since 1986. She is currently involved in evaluating technologies to restore oil-contaminated sites. She says that most communities could benefit from her work because most areas have gas stations with leaks similar to the conditions on which she's now working. Robin is married to an aeronautical engineer and has two young children. She plays the viola in area chamber and symphony groups, and she is a certified pilot and scuba diver. Robin and family live in Pleasanton, Calif.



Nicholas James Etzel

pictures of her twin baby boys, Kevin Joseph Etzel and Nicholas James Etzel, who were born on April 9, 1992. Regina writes that with these two wonderful babies, her household is in as much upheaval as she imagines your class secretary and

**Fern (Crandall) DeVale** is now Engineering Manager at NPS Technologies. She and her husband live in Oakland, N.J. ... **Robe (Rosen) Marcou** recently moved from Anchorage, Alaska, to Plano, Tex. (Dallas area). She is working as a developmental pediatrician at Texas Scottish Rite Hospital. ... Your class secretary and wife **Diane Curtis** enjoyed an Easter weekend visit from Class President **Milton Royce**, his wife, Gloria Lara, and their daughter Kathy. Milton was about to embark on a new job as a program manager with GM-Cadillac. Kathy is already a Trekkie and is the youngest person we've seen who can utter "MIT." —**Jim Bidigare**, secretary, 9095 North Street Rd., NW, Newark, OH 43055-9538, (614) 345-8582

## 79

**Bernard Beard** has moved from private industry into academia. He is a visiting assistant professor of mechanical engineering at Christian Brothers University in Memphis. (Although it conjures up images of winemakers, CBU is actually a small Catholic university with an active engineering program.) Bernard hopes to return to graduate school next year in physics. ... Speaking of academia, **David Fillmore** is an assistant professor of radiology at the University of Utah School of Medicine. ... **Mike Patrick** is spending the year at the Sloan School in the Management of Technology program.

**Jeffrey Bloch** was recently named to the position of instrument principal investigator on Los Alamos's ALEXIS X-ray astronomy satellite project. "In my copious free time (ha!) I've enjoyed a great New Mexico ski season. Last April, I purchased a sail plane that keeps me busy in the summer." ... **Peter Curatolo** graduated from Vanderbilt Medical School in 1983. He completed his internship, residency, and fellowship in diagnostic radiology at New England Deaconess Hospital/Harvard Medical School in 1988. He is now at Beverly Hospital in Beverly, Mass. He married the former Jill Maloney (Wellesley, '80) in June 1980, and they have a 2 year-old daughter, Alexandra.

**Barbara Biber** writes, "My husband and I are getting settled here in the beautiful seacoast community of greater Portland, Maine. Besides working as a radiologist at Maine Medical Center, I've been doing a fair bit of skiing in the winter and windsurfing in the chilly Maine waters during the summer. We also see **Audrey and Paul Lones** a fair bit, as we're practically neighbors." ... **David Baker** and family returned last year from three years of living in England. Baby number three, Cynthia Ruth, was born there just before Christmas of 1990.

Your faithful secretary is about to take her first full week of vacation (i.e., 5 consecutive days) since starting this job 18 months ago. (Believe it or not, I'm still using up 1991 vacation, and it's late April already!) No trip planned, but I open in the musical *Oklahoma!* at the end of the week, and a good low-stress week is in order. Rehearsing the show has been lots of fun. I find myself talking in an Oklahoma accent in some of the strangest places! Till next time—**Sharon Lowenheim**, secretary, 98-30 67th Ave., Apt. 6E, Forest Hills, NY 11374

## 80

Most of the news for this column comes from the notes you send back with your contributions to the Alumni Association. I have received a few notes through the U.S. Mail and computer mail. This month I got my first phone call! **Steve Mickel** moved to Ann Arbor, Mich. (where I now live) in March and gave me a call. His wife and two little ones will be following soon from Maryland.

Two short notes from some busy doctors: **Andrew Braunstein** has a general surgery practice in Orlando, Fla. **Timothy Morgenthaler** is a pulmonary medicine fellow at the Mayo Clinic. His third child and first son, Zachary Isaiah, will be one-year-old by the time you read this. Zachary's sisters are Sarah and Kelsey.

**Susan Pinkus** also writes about her sons Elliot (6) and Donald (4). Susan is busy as a full time mom: a job more important than any other she can think of. She is also very active in a number of volunteer organizations. Elliot and Donald have already visited MIT. ... Wildfire Communications is the name of a new company started by **William Warner**. The company combines speech recognition with a UNIX-based hardware and software environment. The system handles incoming and outgoing phone calls through voice commands.

**Thomas Klein** is executive VP at OFC Corp. in Natick, Mass., and a board member of Altamont Technologies in Livermore, Calif. He and his wife, Vivian, have two sons, Oliver (4) and Nelson (3). ... **Stephen McNamara** is a practicing patent, trademark, and copyright attorney in Stamford, Conn., working on applications licensing and litigation.... My last note comes from **John Muggeridge**. John is living in Waltham where he works at Fidelity Investments and is pursuing a master's degree in environmental engineering.

Late breaking news—I received two computer mail messages just in time to beat the deadline! **Dan Sable** had an exciting 1991. On the autumnal equinox, he married Lynn Sharp in a private ceremony attended by only two other individuals. They spent three weeks honeymooning in Hawaii and New Zealand. Dan received a PhD in electrical engineering from Virginia Polytechnic Institute and State University in December and is now a research scientist at VPI working on the power system for the NASA EOS satellite. In 1992, Dan and Lynn plan to purchase a farm and pursue his life's dream to be a farmer.

News of family life comes from **Ken Turkewitz**. Ken and his wife, Katie, now have three sons: Max (entering kindergarten this September), Avi (the very mischievous middle child), and Lev (born in November 1990). Prior to the birth of their third son, Ken and Katie moved to a larger house in Sharon, Mass. Ken realized that with computer mail he had no excuse for not sending his news and neither do you! Let's make the Class of '80 column the longest. Send your news (by U.S. Mail, computer mail, FedEx, pony express, or call (I finally got an answering machine so I won't miss any important messages!)).—**Kim Zaugg**, secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@erim.org.

## 81

Music, mummies, medicine, and machinery mark this month's messages (gee, isn't that alliterative?):

**Break on through**. After ten long years, **Joseph Gelish** and his band, **OTHERSIDE**, have released their first rock & roll album on an independent label. Joe also reports that he's moonlighting as an ASIC design engineer for Hazeltine Corp., a small company in New York.

**Mothers talk (Fathers too)**: **Vicki Wooworth** writes to say she's still a postdoc, but has been busy with new daughter Joanne, born last May. ... **Jonathan Griep** and his wife Martha Buck, '80, were blessed last February with a son, Joshua Paul, who has quickly become the joy of their lives. Jonathan is still a principal software engineer for Digital in Nashua, N.H., while Martha was just promoted to principal engineer and is now a supervisor at Digital.

**Interventionist**: We learn that **Robert Worthington-Kirsch** is in private practice as a general diagnostic radiologist with emphasis on interventional radiology. Robert and his wife, Kimberly (Wellesley '82), have three daughters, whom they enjoy very much.

**Milestone**: It's been two years in the business now for **Rob Schoenberger** with his company, Subtechnique, Inc., which specializes in industrial video, machine vision, and telerobotics.

**Figuring the system**: **Victor Miller** reports that he continues to work as a systems analyst for Loral Electronics Systems in New York.

Finally, I'm not quite sure how to report this, but this month I received notice, supplied by his father, of the decease of **Michael Bulat**. I say this because



the notice contained a report of Michael's passing in a newsclipping dated 1985. Michael was killed in a fire in the garage of his home in south Palo Alto, Calif. His classmates shall remember him.

That's it for this time. How about some cards and letters from you '81ers who haven't written in lately (or ever)? Come on, let us know what you're up to.—**Mike Gerardi**, secretary, 1515 S. Flagler Dr. #1204, West Palm Beach, FL 33401, (407) 655-5050 (w), (407) 835-9013 (h)

## 82

Please send news for this column to: **Stephanie Pollack**, secretary, 25 Royce Rd., Newton, MA 02159

## 83

### 10th Reunion

Brass Rats in space—we know that it would only be a matter of time until someone from the Class of '83 would put one up. **Catherine G. "Cody" Coleman** may soon get hers to an altitude of 160 miles. Cody was selected as one of 19 new astronaut candidates for the Space Shuttle Program. There were 2,054 applicants, and Cody was one of two chosen from the Air Force.

Cody used an educational delay from the Air Force to attend UMass/Amherst to complete a PhD in polymer science. She has served on active duty since 1987 in the non-metallic materials division of Wright Laboratory at Wright-Patterson Air Force Base in Ohio. She will report for astronaut training in early August and will train to be a mission specialist on some future shuttle flight. Our thanks to Peter Rogers, '82, for providing us with the exclusive on this story.

**Karl Levy** writes that he is now a process engineering manager at Novellus Systems (a TA Associates' portfolio company) in San Jose, Calif. Karl reports that he and **Tom Stepien** are working together at Novellus and weathering the recession just fine. Karl also mentions that he will be getting married at the end of August this year to an unnamed individual. ... **Matthew Bendaniel** writes that he is manager of Consulting at Ontos, Inc., an object-oriented database firm in Burlington, Mass. ... **Jonathan Naimon** writes that he is a senior analyst at the Investor Responsibility Research Center, Inc., a Washington think tank for institutional investors like MIT. Jonathan is currently managing a project examining trends and environmental performance for Standard & Poors 500 (i.e., big) companies. ... **Gardell Gefke** is a graduate student in the space systems laboratory at the University of Maryland/College Park. ...

**Steven J. Isokowicz** is currently working for the Office of Management and Budget (OMB) on space policy for the White House. Formerly, he worked for Martin Marietta in Denver, Colo., for five years. ... **Art Vasen** is living in Ohio, is married, and is a doctor. ... **Ann Tulintseff** has received a PhD and is working at the jet propulsion laboratory in Los Angeles.

Scanning the globe for interesting tidbits on classmates, we came across the following headline in the *Williamsville New York Weekly*: **Robert L. Dimmig**, formerly director of Lackawanna's Economic Development Zone Program, has begun a new position as the executive director of the Town of Tonawanda. During Dimmig's tenure in the Lackawanna position, nearly 180 jobs were created and \$10 million was invested in the region. Before the Lackawanna position, Dimmig was a graduate student in urban planning at the University of New York at Buffalo.

This just handed to me. ... **Mike Santullo** has finally emerged after a nine-month worldwide trip featuring Europe, Africa, southeast Asia, Australia, and New Zealand. Highlights include getting attacked by a pirate vessel while sailing on the Nile, death defying trekking in Nepal, and an obligatory bungee jump in Queenstown, New Zealand (the big one, not the little one, for those of you who have been there). Mike still hasn't gotten the travel

bug out of him and is off again for a shorter stint to Europe. More details as they become available. ... Please keep the cards and letters coming.—**Jonathan Goldstein**, secretary, TA Associates, 45 Milk St., Boston, MA 02109

## 84

**Will Gaherty** celebrated the three month "anniversary" of his consulting company, Pottinger Gaherty Ltd. Canada. They are an environmental firm with a staff of five. ... **Wendy Keilin** is following up 18 months of traveling around Borneo and South East Asia, and a year in Australia working for Sun, with another road trip. With her fair dinkum Aussie companion Michael, they will be setting off in a '75 Aussie-made "Golden Holden" for a nine-month odyssey around the eastern half of the Australian continent. ... **Daniel Felten** is working as a project manager for a large environmental consulting firm. He has a 2-year-old daughter and the family is looking to transfer to the United Kingdom in a couple of years.

On the wire from our President, **Diane Peterson**: the Class of '84 Scholarship recipient last year was Charles Pickelhaupt of Bangor, Maine, and Theta Chi. Thanks to all class contributors and let's help send more folks to our grand old school. ... **Clifford Denker** and his wife, Jill Solan Denker, are the parents of Marisa Beth soon to be a year old. Clifford is in his fourth year with Allied-Signal as a process engineer with the Aquatech subsidiary. ... **Joonkee Hong** has joined the Financial Strategy Group at Salomon Brothers specializing in swaps (hmm), derivatives (double hmm), and liability management.

**Stephen Altes** left Orbital Sciences Corp. and has joined John Langford at his start-up Aurora Flight Sciences. They are building remotely-piloted aircraft for high altitude atmospheric research. ... **Nicholas Strauss** provides computing support for Boeing Helicopters. Nicholas, his wife, and baby, Alexandra, live on a horse farm. He spends his free time mucking stalls and doing recreational mathematics (do these two relate?). ... **Ken Zeger** is on the move leaving his assistant professorship at Univ. of Hawaii for Univ. of Illinois/Urbana-Champaign. Ken has also been playing a lot of water polo with a team in Honolulu. ... **Gil and Linna Ettinger** have packed it up and moved from the west coast back east. Their daughter, Alyssa, helped them pick out a new house in Lexington. Gil is working for TASC in Reading.—**Howard Reubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home), hbr@mitre.org.

## 85

Greetings again from sunny but riot-torn California.

More news from the reproduction front: **Michelle Saxton** reports that her daughter Lindsay was born almost two years ago in August 1990. Michelle is pursuing a PhD in marketing at Indiana University while her husband studies for a PhD in strategic management. In 1991, she joined a management/marketing consulting firm, The Barnegat Group.

**Kentaro Horiuchi** and his wife were blessed with the birth of their son Kenji Mark in June 1991. ... **Alan Foonberg** received his private pilot license in January and is enjoying relief from the Los Angeles automobile traffic. He and his wife, Lisa, are enjoying their new baby girl, a 10-month old yellow labrador retriever named Nilla. Alan says that is about all the responsibility that he and Lisa can handle right now. ... **Clara Chung Fleisig** is continuing her residency at the University of Alabama at Birmingham while husband, Glenn, is working at the American Sports Medicine Institute as research director.

**Michael Bernard** sends an update on his humble life. He was engaged to Julia Hsieh, '89, on December 23. Julia is going to be starting grad school in

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# No Money, Little Experience? Start a Business

**M**ost children love to take things apart. But from an early age, Darryl Robinson, '86, could also put them back together, rebuilding machines from anonymous jumbles of parts. His problem-solving skills have served him well ever since.

At 22, equipped with a degree in mechanical engineering and 10 short months experience in the Equipment and Facilities Engineering Department at Polaroid Corp., Robinson officially launched Robotica Automation Consultants in July 1987. Headquarters for the operation was "half of my bedroom cordoned off," says the 27-year-old, African-American entrepreneur, and the apartment was not on corporate row: it was so close to Fenway Park he could hear the shouting from the bleachers during home games.

While still at Polaroid, Robinson had adapted a spreadsheet for the accounting firm C.J. Royster and set up a mailing list for Prosper Publications, a newspaper for minority businesses. Though these modest projects brought his new enterprise on line, the work wasn't what he dreamed of and his hours were long. "I didn't want to slack off at Polaroid, so I had what I called the second shift," he says. "I'd come home and eat, maybe take a nap, then get back up and start doing Robotica stuff."

His hours haven't changed much since he left Polaroid in 1987. But thanks to Robinson's strategy of asking each client for a referral, the company now does quality assurance tests for new software, develops and tailors software for a diverse clientele, supplies technical support, and teaches corporate employees to use computer systems.

Lotus Development Corp. hired Robotica to help hammer bugs out of pre-market versions of Symphony, its

One Source products, and the ill-fated demographic software, Marketplace. Robotica software engineer Greg Yearwood modified a program that tests recognition and response time in



Alzheimer patients for researchers at Massachusetts General Hospital. And Polaroid retains its ex-employee to fine tune a computer system that measures and plots film quality.

Closest to Robinson's heart, though, is his work on data acquisition systems for Ionics Corp., manufacturer of desalinization systems and Aqua Cool bottled water. "It's feedback control," he says enthusiastically.

ly, "something straight out of the Institute. It combines computers and mechanical engineering, which has been my goal since day one."

Robinson launched Robotica with \$1,000 in savings and six major credit cards. During his first three months, he was in the red for \$381. Business has greatly improved—he's not ready to say how much—but enough for the U.S. Small Business Administration to name Robinson the 1992 Young Entrepreneur of the Year for the New England region.

Robotica also placed fifth in *Urban Profile* magazine's 1991 "30 Under 30" competition, which judges business savvy and commitment to community service among young African-American entrepreneurs. "It's really true that you have a responsibility to help those less fortunate," says Robinson, who has led seminars on goal-setting and personal excellence for minority high-school and college students.

This past April, he returned to MIT to address the Society of Black Mechanical Engineers. "Darryl's message was that black engineers need to be leaders instead of followers," says Society President Alvin Ramsey, '92. "It was a universal message, but one that black mechanical engineers need to hear most, since there are so few of us. We need to pave the path for more to follow."

Robotica now has a compact office behind Copley Square, and the roar of Fenway Park is just a memory. But the company still runs lean. Robinson is president and sole full-time employee, with four associates, two of whom are fellow MIT grads: programmers Ken Granderson, '85, and Wil Jimerson, '92.—Francesca Coltrera □

*The author is a freelance writer based in Somerville, Mass*

electrical engineering at USC this fall, while working part-time for Hughes. The wedding plans are going slowly, with a tentative 1994 wedding planned. Mike is still at TRW and was promoted to staff systems engineer in February. He was nominated to the MIT Alumni/ae Association National Board of Directors for a two-year term as a young member at large. He would appreciate any comments, wishes, suggestions, etc., from other young

alumni/ae on what the Board could do for all Alumni/ae.

**Chun-Nip Lee** reports that he received a National Science Foundation postdoctoral fellowship in mathematics which will keep him employed for the next three years. ... **Jeffrey Chang** has been working in the Japanese Applications Group of Claris, the software subsidiary of Apple Computer, in Santa Clara, Calif., for the past year. ... Architect

**Hisaya Sugiyama** is surviving hard times in New York City and still working for Kohn, Pedersen, Fox Associates. He wonders if there are any classmates from Course IV in the Big Apple. ... **Megan Claps** is working as a veterinarian in a small animal emergency medicine hospital in Atlanta, Ga. ... **Celia Lee** works on thermionic energy conversion for deep space applications and designs funky clothing for fun. She has had a few fashion shows at



Boston clubs.

**Craig Kesack** was married in October 1991 at a ceremony attended by **Alan Stoddard**, **Scott Bercel**, **Lou Martinage**, **Dan Flores**, **Alberto Gomez**, **Scott Warner**, **Paul Kegelmeyer**, and **John Swartz**. **John Tenney**, '82, would like to join the Class of '85 because his class never has any news.

Of last months sweepstakes winners, there is news of only one: **Deborah Rice** had her first child within the last month, and was too busy to respond further. Both **James Bittman** and **Harry Gries** appear to have moved. This months winners are **In H. Kim**, **Steve Mekenian**, and **Joseph Hsu**. The e-mail addresses for this month are: **Michael Bernard**, /PN=MICHAEL.L.BERNARD/O=TRW/ADMD=TELEMAIL/C=US/@sprint.com; **Matt Birkholz**, birkholz@crl.dec.com; **Megan Donahue**, megan@ociw.caltech.edu; **Steve Soaresi**, steve@tesla.mitre.org.

**Bill** "I-thought-the-ticket-said-Oakland" **Messner** set a new land speed record from Oakland airport to San Francisco airport when he arrived at the former only to discover that his plane would depart from the latter 40 minutes later. Send news.—**Bill Messner**, secretary, 2234 Jefferson Ave., Berkeley, CA 94703, (510) 845-8119, messner@cmls6.berkeley.edu

## 86

Well, we survived the riots of Los Angeles. Luckily Erik and I were out of town during most of the trouble. I received a few tidbits from the alumni office but the letters are few and far between. Please drop me a line and make my job easier.

**Theresa Devlin** of Jamaica Plain, Mass., is pursuing a PhD in organic chemistry at Northeastern University. . . . **Julie Chen**, a fellow softball player, has been named assistant professor of aerospace and mechanical engineering at Boston University's College of Engineering. Julie specialized in the mechanics of composite and fibrous materials. . . . **Stephen Robbins** is still working for Intuit in Silicon Valley. He is the project manager of a rather revolutionary financial software product due out later this year. . . . **Jehanbux Edulbehran** gave up his job last year with Intel Corp to study city and regional planning at UC/Berkeley. . . . **Glen Parker** works for a consulting firm, NoteSystems, which is actively developing software for pen-based computers.

**Linda Kukulich** and her husband **Steve**, '85, are expecting their first child in August. Congratulations! . . . **Jim Boyles** is now at the Mathworks, Inc., as a Macintosh product manager and GUI designer. . . . **Paul Salinas** is still in Boston doing research for Repligen Corp. in the HIV vaccine program. He is considering grad school at the Harvard Immunology Dept. if he gets offered an invite. . . . **Betsy Salkind** presented "All My Life" at the Institute of Contemporary Art in Boston in February. Based upon the baby book her parents put together during her childhood, the show contrasted pages of the book to her real life. Betsy is also working on a film called "Come Here I'm Not Going to Hurt You," a "surreal black comedy about child abuse." Please write!—**Mary C. Engebret**, secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (310) 376-8094

## 87

So now that you've gone to the Reunion, you found you wanted more information about your classmates? You should have thought about that back in April when I was writing the Class Notes!

I'll give you a few tidbits, but next month it's up to you. Your class secretary got some new news at the Reunion but she needs your help to fill in the rest. Come on. . . . Please. . . . Remember all the details of the conversations you had with your long lost friends, write it down, and send it in.

**Al Cangahuala** gave me a call last week. He just finished his thesis defense in aero/astro at MIT and will be graduating in June. Later that month he will

take a position at JPL, working on the navigation for the Mars Observer Mission. Way to go! . . . **Jay Cohan** took that call. He is enjoying living in New York City and working for Syntra, a small company specializing in exporting. Jay is also taking singing and piano lessons. Watch out, Billy Joel!

Last week I attended Chuen Taj-Choi's Bridal Shower. Chuen is engaged to Buzz Moshetti, '86. They are planning an August wedding. Congratulations! . . . **Linda Elkins-Bohlen** writes: "We're about to have our first baby, due in March. What an adventure! At the same time, my plan-writing business is growing. I do a lot of high-tech plans and it's a lot of fun." . . . **Evans Pratt** writes: "I am currently employed with a mid-sized civil consultant, doing a lot of environmental work." Evans just recently passed his Professional Engineer's License test and is keeping busy in Ann Arbor, Mich., by playing rugby with a good University of Michigan team, playing City Hoops, and watching Division I sports.

**Kimberlyann Chasteen Bowmer** writes: "I am a patent attorney at the NASA Langley Research Center in Hampton, Va. Doug Bowmer and I were married last November and in our free time we enjoy skydiving, scuba diving and playing with our spoiled-rotten Rottweiler, Heidi." . . . **Warren Katz** is VP of Mak Technologies, a small computer company specializing in military virtual reality. . . . **Adam Slohn** writes: "I am working as a design engineer for United Technologies Optical Systems in West Palm Beach. I completed a master's degree from Florida Atlantic University in December 1991 in mechanical engineering. I am getting married in Philadelphia in May 1992 to Mareen Ambs and I am currently applying to MIT, Wharton, and Stanford Business Schools for fall of 1992."

**Stacy Katchman** is engaged to Paul Horenstein, whom she met in medical school. He is a resident in orthopedic surgery at Thomas Jefferson University Hospital, where Stacy is a resident in pediatrics. They will be married in November 1992. . . . **Brent Williams** is working at Lockheed Engineering & Sciences Co. at NASA Langley Research Center. . . . **Rovena Sobarzo** is enjoying her work at Eli Lilly and Co. in Indianapolis as a process engineer. She spent three weeks in Chile last Christmas visiting relatives and had a great time!

The following was published March 20, 1992, in the *Kennebec Journal* in Augusta, Maine: "Navy Lt. **Charles T. Chase** of Richmond, recently received two Air Medals and two Navy Commendation Medals. Chase was cited for heroic achievement in aerial flight while serving with Fighter Attack Squadron 35, based at Naval Air Station Oceana, Virginia Beach, Va., where he is currently assigned.

That's all folks! Take care and WRITE!—**Stephanie Levin**, secretary, 230 Central Park South, Apt. #2D, New York, NY 10019, (212) 397-9616 (h)

## 88

**Steve Beaudoin** writes of his escapades since MIT (. . . four years ago! It's about time!) He received a master's in chemical engineering from UTexas/Austin in August 1990. He worked on an acid-rain abatement technology under the direction of Gary Rochelle, '70. Steve is now at North Carolina State University, studying for a PhD in chemical engineering. He is really happy at NC State, where he shares an office with **Elaine Habal**. In August 1991, he became engaged to Diane Bauer, whom he met in Austin. They are planning a March 1993 wedding. I guess congratulations are in order!

Steve has also spoken with **Marybeth Wall**, **Mark Hanson**, and **Norm Chen**. They are all doing very well. Marybeth and Mark are working towards PhDs in chemical and aeronautical engineering, respectively. Norm is finishing his third (fourth?) year of medical school. . . . **Glenn Hopkins** has recently returned to Boston after a six-month stint in London pursuing leveraged buyouts for the Thomas H. Lee Co. . . . **Mary Lou Ravese** sends a postcard from the Olympics. She and eight other colleagues are skiing at Les Arcs, the site of the speed skiing competition. She transferred

offices in November from New York to Sophia Antipolis in France, right on the French Riviera. She is living in an apartment in Nice, across from the beach. Life really sounds rough!

**Julie Levine** is graduating from medical school in May. She plans to stay in Miami for a residency in pathology. She is also getting married in May to Gregg Friedman, a psychiatrist, and they are planning a honeymoon in British Columbia and Alberta. Congrats! . . . **George Huang** will be doing a general surgery residency at the University of Washington, Seattle. . . . **Steve Stein** is doing a year of preliminary medicine at Columbia P&S, after which he will be doing a residency in anesthesia at the same medical center.

I will be staying at NYU for my general surgery residency. I would love to hear from the rest of you as to where you are, where you are going, what you are up to. . . you get the picture. Write me: **Grace Ma**, secretary, 19 Candlewood Rd., Lynnfield, MA 01940

## 89

I was distressed when I opened up the deadline notice for Class Notes to find absolutely no little slips of paper! I started to panic; then, just a few days before the deadline Ning Peng, the Class of '90 secretary, was nice enough to send me a bunch of the little slips that *Technology Review* had erroneously sent to her. Now, past deadline, I'm here in lab during the two-day reading period working late into the night to finish these notes. Here goes!

First things first, I must correct an error. **John P. Kerekes**, '83, wrote to point out that had Frank Perdue of chicken fame founded a university, it would have been appropriate for it to have an aero department. My apologies (especially to John, who did his graduate work there) for misspelling Purdue. . . . **Debra (Miller) Koker** writes to say that she married Greg Koker (RPD) in February. After three years at Analog Devices as a process development engineer, Debra is returning to MIT to do a PhD in Course III. . . . **Theresa Brennan** finished an MS in electrical engineering from the University of Virginia in August 1991 and began working for GE Aerospace in Utica, N.Y., in the Edison Engineering Training Program. After six months in the digital design area, she is now on a six-month assignment working on infrared sensors. Theresa is engaged to another GE engineer and will be married on June 26, 1993.

**Laura (Ryzowicz) Rapacioli** is still working for Textron Lycoming as a heat transfer engineer. Laura and her husband, Mark Rapacioli, '87, were expecting their first child in June. . . . My old roommate **Sam Drucker** recently got engaged to Anna Cinager, SM '91. . . . **Sayan Chakraborty** writes that he saw Sam, Anna, Beth Kulas, '90; Terry Olkin, '88; Cathy Sybert, '88; **Tim Sulzbach** (NYC), Toby Sanders, '90 (NYC); and Lynn Chewing, '90 (DC), at the annual Brockmen ski trip in Park City, Utah, this past February. Also present (and all from the Penninsula) were Andy Brockman, '88; Chris Racicot, '88; Denis Gulsen, '88; Laura Fleming, '90; Billo Naravane, '90; and Julie Wissink, '90. Unfortunately, **Phil Kuhn**, who was working hard at Oracle, and Desmond Davis, '90, had to cancel. Terry (back in Boston) and Cathy (back at MIT) are planning to get married in August.

Sayan also writes that he and Julie got engaged on March 19, and are planning to get married during the early summer of '93. Sayan is currently doing systems engineering at Trimble Navigation in Sunnyvale, Calif., while Julie is finishing her second year at Stanford Medical School. Sayan says that the Silicon Valley is awash with alum. He sees **Joe Lichy** (in San Jose) and **Elizabeth Greyber** (Stanford Med) from time to time along with other Stanford students including Erica Wickstrom, '90; Walter Chung, '90; and Rick Marks, '90. Rick was married last October in Palo Alto.

**Jon Flight** and **Bill Maney** are rooming together in San Francisco, and **Phil Cohen**, '86, is there. **Lee Gächter**, '86; **Dan Mittleman**, '88; and **Dave Berners**, '90; are in the area also. By the way, I ran into



Bill along with **Angeli Salgado** and **Thespina Hadjimichael**. Bill had come out to celebrate Angeli's birthday, and I happened across them at the harp recital of Dawn Watkins, '92, where she performed works of Hindemith, Faure, Glinka, and Ravel's Introduction and Allegro with string quartet and winds (I was playing violin).

**Alice Lin** and **Livia Racz** had solos in the Bach St. Mathew Passion performed here at MIT. Alice has been staying active in MIT music, playing viola in the MIT Symphony and violin in the Chamber Music Society. Alice is leaving her job this August to start at Tufts Medical School in the fall. I've also been keeping pretty busy with musical groups, playing violin, viola, and harp in the MIT Symphony, Chamber Orchestra, MTG, Brass Ensemble (Hindemith work with two harps and Dawn Watkins, '92, on first harp), and Chamber Music Society. No more goofing around for me next year, though, as I will be working on my thesis proposal soon.

**Matthew McCarty** is an engineer at Grumman Aircraft, and is a member of the AIAA Long Island section and an advisor to the council. ... **Louis Soloff** is studying American history at the University of Iowa. ... **Tim Steele** is still working for NCR in Atlanta, Ga., even though he has lived in four different places since graduation. ... **Kurt Carlson** graduated from Dartmouth College with an MS in electrical engineering last June. Kurt is also living in Atlanta and doing some consulting while he is looking for full-time engineering work.

**Regina Valluzzi** is working in corporate research for Akzo Computational Chemistry and Rheology. Regina is finishing a part-time MS program at Polytechnic this spring. ... **Gary Rahl** graduated from Harvard's Kennedy School of Government with a master's in public policy in June 1991. Gary is currently in the Navy working as an engineer, and is attending the Bettis Reactor Engineering School at the DOE's Bettis Atomic Power Lab. He was in Pennsylvania until the end of July.

**Wendy Woods** is employed by the U.S. Coast Guard Research and Development Center in Groton, Conn., in the Environmental Safety Branch. Wendy is working to implement the Oil Pollution Act of 1990. ... **Daniel Pugh** is in his first year of Law School at the University of Maryland. ... **Patricia Roxas** is living in Rocky Hill, Conn., and is coordinating the design and introduction of a new sliding door product line. ... **Renee Oatway** and her husband are enjoying life in the suburbs. Renee is finishing her first year at Harvard.

**K'Andrea Bickerstaff** writes that "**Valerie Feliberti** married Michael Duke in her hometown of El Paso, Tex., on December 27, 1991. Before the wedding, Vanessa Feliberti, '91, (Valerie's sister); **Anne Marie Atencio**, Hope Cooper, '90; and I barraged Mike with impudent questions. Mike, sweet guy that he is, passed with flying colors. The happy couple resides in a suburb of Houston, Tex."

K'Andrea is currently at the University of Texas at Austin finishing a master's in electrical engineering and also writes that **Alfonso "Bengie" Amparan** completed a master's in electrical engineering this semester at University of Texas and will be starting work this summer with HP in Colorado; and **Charles Robinson**, '90; is also at Univ. of Texas working on an MS in electrical engineering.

**Wendy Wang** is doing a PhD in electrical engineering at Stanford. ... **Ting Kao** should be getting a master's degree this June from UC/Berkeley. She's writing her thesis and working at Cypress at the same time. Ting lives in San Jose, Calif. ... **Sue-Hane Hsu** got a master's degree when she was in England this past December and now is living at home near L.A.

The rest of this column comes by way of **Judy Chen** who is living in Ashdown House. Freshman roommates **Judy**, **Josephine Cheung**, and **Helen Meng** are all at MIT in PhD programs. Josephine lives in the new graduate dorm, Edgerton Hall, and Helen lives in Tang. ... **Ily King** is working at Maxim in Sunnyvale, Calif. ... **Lisa Liou** is working toward a PhD in electrical engineering at University of Rochester in New York. ... **Tammy Chu** is at SUNY as a medical student. ... **Andrew Tomkins** is at Carnegie-Mellon Univ. pursuing a

PhD in computer science. ... **Jolly Chen** is also in a PhD program in computer science, but at UC/Berkeley. ... **Scott Ramsay** and **Lisa Shane** are both working at the Prudential Insurance Co. Scott is very much involved in two local theatre groups. ... **Susan Lee** works at Teradyne in Boston. ... **Suchat (Pern) Saelim** is a medical student at Boston University.

Thanks to everyone who wrote. Since most of it came in after the deadline, I've used up all the news for the next issue, so please some more!—**Henry Houh**, secretary, 4 Ames St., Cambridge, MA 02142, (617) 225-6680, e-mail: tripleh@athena.mit.edu or henry\_houh@mit.edu

## 90

**Stefan Treatman** just finished his first year of graduate school in a PhD program at the University of Michigan. In his spare time, Stefan organized a Math Department football team which went 0-4, but he says that they'll be ready for next year! Stefan also kept busy by playing basketball. He made the University of Michigan varsity basketball team as a walk-on. He said Coach Fisher was great, although he didn't get any playing time in the Final Four. While in New York recently, Stefan saw **Dave Bitko**, **Dan Tauber** and **Mark Henault**.

**Eddie Hernandez** and **Cyndi Downey** were engaged on Valentine's Day. Eddie has an apartment in Belleville, Mich., and is still working at Ford Motor Co., test driving half million dollar prototypes. Cyndi recently moved to Canton, Mich., from Alabama and is working for Johnson Controls Research & Development. Her boss is also from MIT—Joanne Cole, '72. ... In January, **Tricia Wilson** passed her qualifiers at the University of Michigan and is now well on her way to a PhD. Earlier this year, Tricia became engaged to John Nguyen, '87. In December, Tricia, Cyndi Downey, and Eddie Hernandez had a party for recent MIT graduates in southeastern Michigan. They found over 60 alumni without even contacting the Alumni Office but because of the icy Michigan weather, only about 30 people showed up at the party. However, they all still had a great time!

**Karla Lehtonen** married Bill St. Clair, '78, on April 20, 1991. They are now living in the Berkshire Mountains and having a wonderful time caring for their newborn son, Christopher. ... **Mark Henault** received a master's degree in mechanical engineering from MIT in June 1991. Since then, he's been working in the Plastics and Trim Products Division of Ford Motor Co. in Michigan.

**Christopher Bogan** is working in New Jersey for Merck. He's developing a system for automating laboratories. ... **Paul Krause** is working on artificial intelligence research for Systems Research & Applications Corp. in Arlington, Va. ... **John Driscoll** is pursuing a PhD in economics at Harvard. ... **Laura Scolnick** is in graduate school at the University of Pennsylvania. ... **Janet Fordunski** is working in Irvine, Calif., for the geotechnical consulting firm, Ninyo and Moore, and says hello to all Bexleyites!

**Laura Fleming**, **Julie Wissink**, and **Sayan Chakraborty**, '88, are sharing an apartment in Mountain View, Calif. ... **Erica Wickstrom** took a break from her studies at Stanford and travelled to Hawaii, where she ran into Andy Shaw, '89. ... In March, **Rob Bettiker** spoke at the Tufts Community Union Senate. He spoke in favor of a resolution which recommends to the Tufts Administration and Board of Trustees to ban ROTC scholarships by 1998 if the Department of Defense does not reverse its policy of banning homosexuals from the military. Before the night ended, the Senate had passed the resolution.

**Ephraim Lin** is working in Japan at International Investment Consultants, which does market research primarily for foreign companies entering the Japanese market or expanding their operations in Japan. Ephraim has been keeping in touch with other MIT alumni/ae in the MIT-Japan program but he's still interested in locating other alums in Japan. So, if you're in Japan and interested in meet-

ing other alumni/ae, call Ephraim at this number: 81-03-5382-4989 (home).

**Max Ochoa** graduated last December from the University of Michigan with a master's degree in aerospace engineering. While at U of M, Max went to many Michigan football games and ran into fellow Bakerite Jennifer Lund, '89. **Don Euwart** and **Andrew Knoedler** also visited Max many times. Now, Max is living in the North End in Boston and working for GE Aircraft Engines in Lynn, Mass., with **Cecilia Stofas** and lots of other MIT alumni! Recently, Don Euwart, **Maureen Kenneally** and Max returned from an one week vacation in Mazatlan, where they body surfed and got stung by jellyfish! Don works at John Brown Consulting in Stamford, Conn., and Andrew Knoedler is stationed at Wright Paterson Air Force Base in Ohio.

**Jean Liu** is in medical school and is getting ready for her Board exams. ... **Renata Pomponi** is working at MITRE and has just finished a successful season with the MIT women's water polo team. ...

**Alissa Fitzgerald** just received a master's degree in Course XVI at MIT and is going to work for Orbital Sciences in Phoenix, Ariz. To celebrate, she had a huge party in Boston. Among those attending were **Beth Kulas**, **Max Ochoa**, **Yvonne Grierson**, **Don Euwart**, **Shin Hirose**, **Beverly Sailor**, **Charissa Lin**, **Henry Houh**, '89, and **Derek Chiou**, '89.

Finally, just recently, I took a short vacation to Spain, where I visited Madrid, Seville, and Barcelona. I'm now getting ready to move back to MIT to pursue a master's degree at Sloan. In the meantime, please keep sending news to my New York address and it will be forwarded. Let's hear about what everyone did for the summer!—**Ning Peng**, secretary, 355 South End Ave., Apt. 27G, New York, NY 10280

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**Michelle Bush** is a counselor at Boston City Hospital's HIV testing clinic and a tutor of chemistry and biology at MIT in the Experimental Study Group program. ... **John Kimble** is working for Mars & Co., a strategy consulting firm in Greenwich, Conn. ... **James Davenport** is working for the U.S. Air Force as air weather systems' chief software engineer.

**Garrett Love** is teaching high school pre-calculus in Arkansas. ... **Dawn Mitzner** sends news that her fiancé, Paul LaPorte, '88, has joined her in Baltimore. She reports that **Jacquelyn O'Bryan** is working in San Diego and is doing a lot of sky diving.

**Sharra Davidson** is working on the budget of the Bush campaign. She came back to MIT for Burton's DTYD party and caught up with several classmates. She reports that **Steve Colten** is enjoying his new job at First Boston. ... **John Conger** and **Will Gorgen** are working on master's degrees at MIT. Will's current project involves designing a wind-surfer fin, so he was obliged to travel to Aruba to further his research. Poor, poor Will. ... **Amy Thorsen** is "loving" medical school.

**Nicola Bird** sent a postcard from her trip to Arizona. After spending one day cliff-diving and sliding down natural waterslides in Arizona's Oak Creek Canyon, she spent the next day frolicking in mountaintop snow and visiting the Grand Canyon. (On her next vacation she will rollerblade down Mount Everest and pogo-stick across the Sahara.) She shares news about her dinner with **Ajay Advani** and **Christina Liu** in Princeton, N.J. Ajay had recently returned from several months of travel in India. Christina works for Intel in Oregon and was in Princeton working for one of its branches. ... **David Carroll** is working with Guatemalan refugees in Mexico. ... **Dan Schmidt** and his company, Blue Sky, have come out with a new computer video game called Underworld. Nicola says, "It's great! You should try it out!"

Thank you to all those who sent news this month. We have now heard from more than a fifth of the class, so I am looking forward to news about those who will write in the year to come. Please write.—**Andrew Strehle**, secretary, 12 Commonwealth Court #10, Boston, MA 02135, (617) 232-2261



## I CIVIL ENGINEERING

**Roberto L. Lenton**, SM '73, PhD '74, writes: "I continue as director general of the International Irrigation Management Institute (IIMI), headquartered in Colombo, Sri Lanka. The institute is now part of a world-wide network of 16 international agricultural research centers in the Consultative Group on International Agricultural Research (CGIAR), co-sponsored by the World Bank, UNDP, and FAO. IIMI has a budget of \$10 million and a staff of 350 in 10 countries of Asia and Africa." ... **Jonathon C. Goldman**, SM '84, is chair of the Mayor's Commission on Environmental Affairs in the city of Oakland, Calif. ... **Frank W. Clark**, SM '79, reports: "In December 1991, I relocated to Leeds, England, with my wife Stacy to manage a start-up subsidiary of GZA GeoEnvironmental Technologies, Inc., located in Newton, Mass. The subsidiary, Aquaterra Environmental Consultants, Ltd., is doing environmental consulting in areas of contaminated land, ground-water pollution assessment, remediation of contaminated sites, environmental regulatory compliance, and related geo-environmental areas." ... **Juan Antonio Poblete**, SM '69, is a professor at Universidad Gabriela Mistral and is president of a consulting firm in Santiago, Chile. ... **Major Pat Leake**, SM '84, writes: "Michele and I are proud to announce the birth of our sixth child, Evan Joseph, born December 13, 1991, in Kansas City. We now have four girls and two boys ranging in ages from 8 months to 11 years. We arrived back in Kansas last summer from Fort Hood, Tex., where I completed my assignments as operations officer and executive officer of the 17th Engineer Battalion, 2nd Armored Division. I am now teaching a warfighting tactics seminar at the Center for Army Tactics in the U.S. Army Command and General Staff College in Fort Leavenworth, Kans."

From Athens, Greece, **E.L. Bourodimos**, SM '63, PhD '66, sends word: "After 25 years of teaching and research at Rutgers, I retired July 1, 1991. I am considering myself a 'retired professor.' I am working now on my books and lectures, and I am advising the Ministry of National Economy of Greece on matters of environmental quality and development of Greece related to the EE Commission." He was honored for his "scholarship and efforts on behalf of Greek culture and heritage," by the Office of Education of Greek Orthodox Archdiocese of North & South America at a Greek Letters Day banquet. Bourodimos gave a lecture entitled "Environmental Protection and Economic Development" at New York University this past April. ... **Andrew F. McKown**, SM '78, has been named an associate at Haley & Aldrich, Inc. Previously, he was a consultant at the Cambridge-based firm. ... **Steven B. Lipner**, '65, SM '66, has been named director of Information Systems in the newly formed Center for Information Systems at the Washington Group of the Mitre Corp. in McLean, Va. He joined Mitre from the Digital Equipment Corp., where he had been employed for the past 11 years, most recently as manager of the Secure Systems Group. Lipner actually rejoined Mitre, where he had worked in the company's Bedford, Mass., operations for 12 years before going to Digital. In his new position, Lipner will be involved in information systems acquisition strategy and investigating new government initiatives. He will also help develop in-house information systems strategy as well as R&D programs.

**William T. Corpus**, SM '84, has been awarded a "Boss" Kettering Award by the General Motors Corp. for taking part in the invention of an "expert system which assists engineers in designing experiments and in statistically analyzing the test data." Named for GM's late VP and inventor, Charles F. Kettering, who himself held more than 140 patents, the award encourages, recognizes, and rewards GM inventors for technical creativity and leadership. Along with a trophy, each winner also receives a monetary stipend. ... **Robert E. Meyerhoff**, '44, founded a scholarship program in 1988 at the University of Maryland in Baltimore, for academically gifted African-American students committed to studying science. According to the *New York Times*, Meyerhoff created the program with an initial grant of more than \$500,000 from the Robert and Jane Meyerhoff Foundation (the total has grown to more than \$1 million) because he had been disturbed by the plight of so many young African-American men. The program, which now includes female students, has drawn national attention and financial contributions from the NSF, the National Aeronautics and Space Administration, American Telephone & Telegraph, and Apple Computer. Of 70 Meyerhoff Scholars enrolled thus far, only one has dropped out, changing to a non-science major. Meyerhoff, who is white, is a 68-year-old philanthropist and businessman. "It has been extremely gratifying," he told the *Times*, "I always felt that black students had more disadvantages in the sense of not having the economic advantages that a typical white college student had."

**Sallie Watson Chisholm**, Course I professor and director of the MIT/Woods Hole Joint Program in Oceanography, has been named a Fellow in the Evolutionary and Environmental Biology section of the American Academy of Arts and Sciences in Cambridge. ... **John T. Germaine**, SM '80, ScD '82, a Course I principal research associate, has received a Standards Development Award from the American Society for Testing and Materials (ASTM) Committee on Soil and Rock. The award is presented to individuals responsible for the preparation of a standard that is approved by the entire membership of ASTM. Preparation of such a standard is comparable to the writing of a technical paper for a refereed journal. Germaine received his award for the preparation of ASTM Designation D 2435: Standard Test Method for One-Dimensional Consolidation Properties of Soils. His co-author was Jorgen F. Christiansen. ... **Chiang C. Mei**, Course I professor, has been selected by the Waterway, Port, Coastal, and Ocean Division of the ASCE as the recipient of the 1992 John G. Moffatt-Frank E. Nichol Harbor and Coastal Engineering Award. ... **Charles Shiu Wong**, '90, SM '92, has been selected as a winner of one of the 1992 Graduate Student Awards from the Division of Environmental Chemistry of the American Chemical Society. ... **Galvin Gong** has been awarded a NASA graduate student fellowship for the duration of his graduate studies. He works on landsurface hydrology representations in atmospheric general circulation models.

**T. Robert Kealey**, SM '47, of Lemoyne, Pa., died on August 3, 1991. He was a retired managing partner of Modjeski and Masters Consulting Engineering and an Army veteran of World War II. His projects included the Walt Whitman Bridge in Philadelphia, the Grater New Orleans Bridge, and the Newburgh-Beacon Bridge over the Hudson River. Kealey belonged to several organizations

including the ASCE and the National Society of Professional Engineers.

## II MECHANICAL ENGINEERING

**Paul Swenson**, SM '63, sends word from Cleveland, Ohio: "I devoted about half of my professional effort during 1991-92 coordinating the development of product safety and performance standards for natural gas vehicles. Working with the 'big 3' plus ANSI, AGA, and SAE." ... From Bellevue, Wash., **John A. Simo**, SM '91, writes: "I am currently a mechanical engineer with the design group at the Resources Conservation Co. (RCC), a subsidiary of Halliburton N.U.S. Environmental Corp. I am involved with all phases of design at RCC, which specializes in industrial wastewater treatment for electric utilities, pulp and paper, aerospace, and mining, as well as patented solvent-extraction and UV degradation technologies used in hazardous waste remediation. My current projects include wastewater plant design in Guadalajara, Mexico, and PCB remediation in Massena, N.Y." ... **David E. Guza**, SM '88, reports: "I am currently employed by the Battelle Memorial Institute as a research engineer specializing in mechanical and ocean engineering R&D. I have also been extracurricularly involved with the control surface design of Battelle's entry into the International Human-Powered Submarine races last June." ... **William L. Verplank**, SM '67, PhD '77, writes: "This year I'm serving as the PTA president's husband (president: Dolly, 3rd grader: Jansen). Through a happy merger, our firm is now IDEO Product Development (Palo Alto, Calif., San Francisco, Chicago, Boston, London), where I do product design and human factors. This quarter at Stanford, I had the pleasure of helping Terry Winograd, PhD '70 (XVIII), teach a new course on design for human computer interaction."

**James W. Adams**, SM '78, writes: "I am in product support for depot operations for the Lantirn program of Martin Marietta Electronic Systems in Orlando, Fla." ... **Stephen L. Dickerson**, ScD '65, is founder and chair of Dickerson Vision Technologies, Inc. ... From Edmond, Okla., **Lanny Benham**, SM '77, sends word: "I am senior VP of The Benham Group, a registered professional engineering company in eight states. I was recently selected as a captain in the U.S. Naval Reserve. I'm currently serving as commanding officer of Mobile Inshore Undersea Warfare Unit 113. I am a member of the board of directors of The Benham Companies and Roberts-Schornick & Associates (RSA). RSA is a full service environmental company specializing in hazardous waste remedial design and compliance activities." ... **Robert R. Moore**, SM '83, PhD '86 (V), writes: "I am completing a medical residency in family practice in June and have joined Mashpee Medical Associates and Falmouth Hospital. My wife, Donna, and I are also proud to announce the birth of our second child, Michael Cody. He joins sister, Jill Elizabeth." ... **Osama M. Ettouney**, SM '81, is an associate professor in the Manufacturing Engineering Department at Miami University in Oxford, Ohio. He writes: "I teach senior design projects, computer-aided experimentation, and an honor seminar with a history professor, entitled 'Culture and Technology.' My current research is in the area of computer-integrated manufacturing



systems and ergonomics. My educational research is in computer applications for classroom and lab instruction. In addition, I have a strong interest in developing courses in the area of science, technology, and society."

**Walter J. Bornhorst**, SM '64, PhD '66, is now chair of the board at Thermo Fibertek, Inc., in Waltham, Mass. Previously he was chair, president, and CEO of Thermo Process Systems, Inc. . . . **William Menzies, Jr.**, SM '55, has returned from Faisalabad, Pakistan, where he served as a volunteer with the International Executive Service Corps (IESC). Menzies, retired VP of the Woonsocket Spinning Co., was recruited by IESC to assist a manufacturer of jute twine and cotton yarn with improving production and increasing manufacturing efficiency. IESC is a not-for-profit organization of American business men and women devoted to providing managerial and technical assistance to private enterprises in developing countries. Menzies, who lives in Charlotte, N.C., was accompanied by his wife, Mary, on the trip. . . . **Ronald C. Rosenberg**, '60, SM '60, PhD '65, has been named chair of the Department of Mechanical Engineering at Michigan State University. Rosenberg joined the MSU faculty in 1969 as an associate professor and has been a full professor since 1974. He is an expert on computer-aided modeling for mechanical engineers and is well known professionally for his work on bond graphs, a way of showing how energy flows through engineering systems. Also, he developed ENPORT software, used for dynamic system simulation and design. . . . **J.P. Barger**, SM '50, ME '56, of the Dynatech Corp., in Burlington, Mass., has been named a Fellow in the Public Affairs and Business Administration Section of the American Academy of Arts and Sciences.

Former MIT faculty member **George N. Hatsopoulos**, '49, SM '50, ME '54, ScD '56, the founder, chair, and president of Thermo Electron Corp., is one of four recipients of the 1992 Beta Gamma Sigma Medallion for Entrepreneurship. The national award recognizes outstanding individuals who combine innovative business with service to humanity. Hatsopoulos served on the Course II faculty from 1956-62, and continued as a senior lecturer until 1990. His company, which manufactures environmental and analytical instruments, alternative-energy power plants and pre-packaged cogenerative systems, industrial process and power equipment, and biomedical products, has sales of more than \$700 million and more than 5,000 employees. Hatsopoulos holds five basic patents on direct energy conservation and is the principal author of three books and more than 60 articles published in journals and conference proceedings. The Boston Museum of Science named him Inventor of the Year in 1989. Appointed to Massachusetts Governor William F. Weld's advisory council on Economic Growth and Technology, he also served as chair of the Federal Reserve Bank of Boston. . . . Professor **David N. Wormley**, '69, SM '64, PhD '68, MIT's associate dean of engineering, has become dean of Penn State's College of Engineering, effective July 1. Wormley, a mechanical engineer recognized widely for his research in control systems, transportation systems, and fossil fuel energy systems, has been a member of the MIT faculty since 1967. He headed the Department of Mechanical Engineering from 1982 until becoming associate dean. . . . **Jeffrey S. Horowitz**, SM '68, ME '68, ScD '72, president of DuPage Computer Applications, Inc., in Woodridge, Ill., has been elected to Fellow grade in ASME. "He has provided leadership in the resolution of several important problems related to the commercial nuclear power industry. Most recently, he has developed programs (CHEC and CHECMATE) for predicting corrosion and erosion failures in steam power plants," states the January 1992 issue of *ASME News*. Horowitz has been a member of ASME since 1966.

**Robert E. Baker**, SM '63, of Santa Barbara, Calif., died on February 5, 1992. He served as an instructor at West Point for three years, after which he served tours in Alaska, Korea, and Vietnam. He took early retirement from military service, following which he worked at several government pro-

jects in Idaho, Indiana, California, and Washington. He was working at Washington Public Supply System as a procurement manager when ill health forced him into retirement in 1985.

## III MATERIALS SCIENCE AND ENGINEERING

**Mark D. Lipsey**, SM '78, OCE '78 (XIII), writes: "After an interesting year including the Gulf War and the Mt. Pinatubo volcano eruption in Subic Bay in the Philippines, I retired from the U.S. Navy and am the director of engineering at the JW Marriott Hotel in Hong Kong." . . . **George Economos**, SM '51, ScD '54, sends word: "I retired on May 1, 1992, from the National Materials Advisory Board in the National Academy of Sciences. I served as a staff scientist in the National Research Council since 1977, working on various programs in materials science and engineering of concern to the government and the nation. The broad-based background in education and experience during my 12 years at MIT (1949-61) as both student and faculty member, involving chemistry, metallurgy, ceramics, crystal growth, engineering practice, etc., have served me well in my technical career. Close interaction with the MIT faculty has been maintained over the years. My home will remain in the Washington, D.C., metropolitan area." . . . Representative **Don Ritter**, SM '63, ScD '66, a Republican congressman from Pennsylvania, has been elected to the board of trustees at the GMI Engineering & Management Institute in Flint, Mich. Ritter is currently serving his seventh term in the U.S. House of Representatives. GMI is the nation's only accredited college of engineering and management operating on a five-year fully cooperative plan of education. Founded in 1919, GMI was part



D.L. Ritter

of the General Motors Corp. until 1982, when it became an independent institution. . . . **H. Kent Bowen**, PhD '71, Course III professor, has been elected a Fellow in the Engineering Sciences and Technologies Section of the American Academy of Arts and Sciences. . . . **Julian Szekely**, Course III professor, received the Alexander von Humboldt Fellowship and Prize Award from the Max Planck Institute in Germany, in recognition of his research in the field of materials processing. The award will enable Szekely to spend time in Germany, working with scientists at the German Space Research Institute in preparation for a joint space shuttle experiment scheduled for 1994.

A \$2 million gift from Sumitomo Electric Industries, Ltd., of Osaka, Japan, has established an engineering professorship at MIT and made possible the creation of a lecture series and prize honoring an MIT pioneer in electronic materials. The first MIT professor to hold the Sumitomo Electric Industries Professorship in Engineering is **Harry L. Tuller**, Course III professor and director of the Crystal Physics and Optical Electronics Lab. He is internationally recognized for his work on the development and characterization of electrically and optically active ceramics and glasses and their applications to energy conversion, electronic devices, and sensor technology. He has been a member of the MIT faculty since 1975. Professor Emeritus **Harry C. Gatos**, PhD '50 (V), is the pioneering MIT materials scientist whose contributions have been recognized in connection with the Sumitomo gift by the creation of the Harry C. Gatos Distinguished Lecture and Prize in Materials Science and Engineering. The initial lectures were given in December by a Sumitomo representative and by Gatos, who spoke on "The Vacuum Tube to Solid State Electronics Transformation." Gatos, a

member of the Course III Department for nearly three decades, played a key role in the development of the science of electronic materials, especially gallium arsenide. In 1962 he formed the first Electronic Materials Group within a materials department. For some years it was the only academic group devoted to the study and establishment of relationships among crystal growth parameters, structural and chemical composition, and electronic properties. During this work, Gatos formed a close association with Sumitomo Electric Industries, also a pioneer in the development and application of advanced materials. The Gatos Lecture and a \$5,000 prize will be awarded, generally every two years, to an individual who has contributed significantly to the advancement of the field of materials science and engineering.

## IV ARCHITECTURE

**Mary Lou Boutwell**, SM '87, has been named a VP at Spaulding & Slye in Burlington, Mass. Previously she was associate director of MIT's Center for Real Estate Development. . . . **Arno Bommer**, '82, has been elected to full membership in the Institute of Noise Control Engineering. Bommer has been promoted to supervisory consultant at Collaboration in Science and Technology, Inc., in Houston, Tex. He works in the areas of industrial acoustics, environmental acoustics, and architectural acoustics. His recent projects at CSTI have included the modeling of sound levels on an offshore platform, the design of noise control treatments for pipeline compressor stations to meet community noise requirements, and the evaluation of speech privacy and room acoustics at a church, family, and education center. . . . **Kurt A. Levens**, a Course IV graduate student, has won this year's Marvin E. Goody Prize. The \$5,000 prize is awarded annually to a student about to prepare his or her thesis. Levens's thesis, "Centralized Illumination in Buildings," introduces using fiber optics for the transport and distribution of light in a building as a means to facilitate the centralized recovery and reuse of lighting-related energy losses. The prize was established by Joan E. Goody in the name of her late husband, **Marvin E. Goody**, MAR '51, a faculty member who died in 1980. The aim of the award is to encourage work that explores the bond between good design and good building, that extends the horizons of existing building techniques and materials, and that encourages links between the academic world and the building industry. . . . BT, the British telecommunications company, has awarded a \$2.5 million five-year contract to MIT's Media Lab. The lab won the contract to develop new computerized tools to "see" and "understand" visual images. The research will lead to the development of new tools that allow computers to search through films and television footage for particular events and situations.

## V CHEMISTRY

**Robert R. Moore**, SM '83 (II), PhD '86, writes: "I am completed a medical residency in family practice in June and have joined Mashpee Medical Associates and Falmouth Hospital. My wife, Donna, and I are also proud to announce the birth of our second child, Michael Cody. He joins sister Jill Elizabeth." . . . **Ronald S. Sheinson**, PhD '70, sends word: "I am a research chemist at the U.S. Naval Research Laboratory in the Navy Technology Center for Safety & Survivability in Washington, D.C. I am studying combustion processes, especially fire suppression mechanisms. My current research includes finding replacements for halon fire extinguishment agents that are not ozone-layer depleters as are halons. I am a committee member of the United Nations Environment Programme of the Montreal Protocol Assessment." . . . **Jim Bier**, PhD '71, is a coordinator



and professor of chemistry at Ferrum College in Ferrum, Va. He reports: "I am co-director for the NSF Young Scholars Grant for 'Science Adventure in Research and Career Exploration for 30 rising 8th graders for three weeks in the summers of '91 and '92.'... **Timothy P. Curran**, PhD '88, is an assistant professor at Holy Cross College in Worcester, Mass.... **Philip DeShong**, ScD '76, reports: "I was promoted to professor of chemistry at the University of Maryland in College Park. For the past two years I have served as associate chair for graduate studies and research in the Department of Chemistry and Biochemistry. I was appointed to the advisory board of the *Journal of Organic Chemistry*."

**Hans C. Andersen**, '62, PhD '66, professor of chemistry and deputy director of the Stanford Center for Materials Research, has been elected to the National Academy of Sciences. Andersen's principal research interests are physical chemistry; statistical mechanics and its application to problems of interest in chemistry, physics, biology, and materials science; development and use of molecular dynamics computer simulation methods; theory of liquids; and theory of the glass transition and relaxation processes.... **Timothy H. Cronin**, PhD '65, has been named senior VP for Animal Health Products R&D at Pfizer Central Research in Groton, Conn. In his new position, Cronin will be responsible for worldwide discovery and development of products used in animal health care. Cronin joined Pfizer in 1964 as a research chemist. In the early 1970s, he led the team that discovered sulbactam, which overcomes the defense mechanisms certain bacteria use against antibiotics. Sulbactam is a key component of Unisyn and Sulperazon, which last year had combined sales of \$349 million worldwide.... **Winslow H. Hartford**, '30, PhD '33, professor emeritus at Belmont Abbey College in Belmont, N.C., has received the Distinguished Chemist Award from the North Carolina Institute of Chemists.

**Thomas L. Popper**, PhD '62, of Caldwell, N.J., died on February 15, 1992. He was the associate director of chemical research for infectious diseases and tumor biology at Schering-Plough Research Co. in Bloomfield, N.J., for the past 27 years. Popper was a member of the American Chemical Society.... **Arthur S. Nyquist**, SM '36, of Darien, Conn., died on February 24, 1992. He had worked for American Cyanamid for about 35 years before retiring in 1975. He was a member of the 70-plus Ski Club, the Senior Men's Association in Darien, and the Darien Boat Club. He also was director of the Darien Audubon Society and volunteered for Person to Person and the Darien Red Cross.

## VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

**Christine Shadle**, PhD '85, sends word: "I'm now in my fifth year as a lecturer (England's equivalent to assistant professor) in the Department of Electronics and Computer Science at the University of Southampton. My research interests continue to focus on acoustics of speech production; broadly interpreted, this has led to collaborations with people in image processing and aeroacoustics, in France, the U.S., and England. On the personal side, my husband (an engineer trained at the other Cambridge) and I continue to restore our Victorian house, and to go hiking wherever we find ourselves.... From Schenectady, N.Y., **John M. Spinelli**, SM '85, PhD '89, reports: "My wife, Karen, and I had a beautiful baby girl on December 29, 1991, named Teresa Marie!"... **Thomas Kailath**, SM '59, ScD '61, writes: "I received an honorary doctorate from Linköping University in Sweden, in 1990 and from Strathclyde University in Scotland in 1992. I received the 1991 Society Award from the IEEE Signal Processing Society, and I was elected to the Third World Academy of Sciences in the same year."... In recognition of his career-long achievements toward advancing design and test technology within GenRad and the electronics

industry, GenRad, Inc., inducted **Malcom C. Holtje**, '50, SM '50, EE '69, director of the company's microelectronics operations, into its GenRad Fellows Program. Holtje's privileges as a Fellow include "an 'in-service sabbatical' for a



**M.C. Holtje**

specified period of time to pursue research or assignments of his choice, staff designation as a resource to the company on broad technology issues, and the opportunity to select and mentor a candidate for GenRad's Masters in Industry Program. In addition, Holtje will serve as an honorary member of the company's Patent/Award Committee and will be the recipient of an annual allocation to attend the technical seminar or conference of his choice," states a company news release.... The Optical Society of America has named **Mohammed N. Islam**, '81, SM '83, ScD '85, the 1992 recipient of the Adolph Lomb Medal for noteworthy contributions to optics before reaching the age of 30. Islam is cited for "his pioneering contributions to nonlinear optical phenomena and all-optical switching in optical fibers." An OSA news release states, "In the area of all-optical switching in fibers, Islam is a clear world leader in the field. He has combined his experimental and theoretical skills, together with some strikingly original and inventive ideas. In recent work on 'soliton dragging' all-optical switching, for example, he demonstrated what is arguably the first all-optical switch that has all of the necessary attributes of a digital logic gate." Islam works at AT&T Bell Labs in Holmdel, N.J., where he is a member of the technical staff in the Photonics Switching Research Department. He is also a consultant on optical fibers and short pulse generation for Lawrence Livermore National Lab.... **John H. Cafarella**, SM '73, EE '73, ScD '75, has been elected a Fellow of the IEEE for "contributions to the development of surface-wave and other advanced signal-processing components. In 1984, Cafarella left Lincoln Lab to co-found Micrilor, a R&D company which exploits emerging signal processing technologies in systems applications for government and industry. His systems-oriented work at Micrilor has included analysis and systems design for applications including radio and underwater communications, and tactical radars. Cafarella has contributed to the development and application of acoustic charge transport, surface acoustic wave and superconductive technologies, and has fostered radio-frequency applications of photonic components.... **W. Daniel Hillis**, '78 (XVIII), SM '81, PhD '88, founding scientist of Thinking Machines Co., in Cambridge, and **Barbara H. Liskov**, the NEC Professor of Software Science and Engineering at MIT, have been elected Fellows in the Engineering Sciences and Technologies Section of the American Academy of Arts and Sciences.... **Charles L. Seitz**, '65, SM '67, PhD '71, professor of computer science at the California Institute of Technology, has been elected a member of the National Academy of Engineering. Seitz has been a member of the Caltech faculty since 1977. He was honored by the NAE for his "pioneering contributions to the design of asynchronous and concurrent computer systems." Seitz's research is concerned with computing systems whose components provide their own timing and operate concurrently on different parts of a computation. "As part of this research, Seitz and his students developed the architecture, programming methods, and numerous design innovations for multicomputers, the most prevalent form of highly concurrent computer. Multicomputers are leading contenders for the title of 'world's fastest computer,' including the Intel Touchstone Delta located at Caltech," states a university news release.... *Turn Signals are the Facial Expressions of Automobiles* (Addison-Wesley

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Publishing Co., 1992), is a new book by **Donald A. Norman**, '57. Norman is professor and founding chair of the Department of Cognitive Science at the University of California at San Diego. "How long is 'noon'? What do we really mean by 'real time'? Why do we have multimillion-dollar passenger aircraft dependent on three-cent Styrofoam cups placed over ill-designed levers in the cockpit? These are the kind of questions that get Don Norman going, and that give rise to his unique observations on our love-hate relationships with gadgets, computers, and machines," states the book's jacket. His first book, *The Design of Everyday Things*, was called "brilliant," by Marvin Minsky. . . . **Mildred Spiwak Dresselhaus**, MIT Institute Professor, has been awarded an honorary degree from the University of Connecticut. She was one of four women so selected to mark the culmination of a year-long celebration of the 100th anniversary of the admission of women to the university. . . . Course VI Professors **James E. Chung** has been appointed to the Analog Devices Career Development Chair, and **Gregory M. Papadopoulos**, SM '83, PhD '88, has been appointed to the Class of 1922 Career Development Chair. Chung is an expert in semiconductor devices who has been at MIT since January 1991. His research in the Microsystems Technology Laboratories involves extreme-submicron VLSI device physics, modeling and design; integrated circuit technology; and VLSI reliability. Papadopoulos is noted for his work in computer architecture, especially general-purpose parallel computer hardware and programming, and for the effectiveness of his teaching. He recently completed the design of the Monsoon data-flow computer. His broad technical background has allowed him to work effectively in both electrical engineering and computer science areas. He is currently involved in the revision of the 6.004 subject, computer architecture. He joined MIT in 1988 as a research associate and became an assistant professor in 1990.

## VI-A INTERNSHIP PROGRAM

Your reporter is composing this article when only three more days of Spring term classes remain in May. Director **Kevin O'Toole**, SM '57, NE '57 (XIII), has given me the final selection figures for this summer's incoming VI-A class of 1992. Of the 201 applicants, 78 have been accepted by the 21 companies making selections. Of these 78, 10 are juniors who did not have a previous chance to apply as sophomores. These figures compare with last year's 197 applications and 78 acceptances.

My VI-A column, in the upcoming October issue of *Technology Review*, will report on the VI-A 75th anniversary celebration of June 5th and 6th.

VI-A's continue to receive honors and awards, and this spring is no exception. Receiving the 1992 IEEE Leadership Recognition Award is **Bernard M. Gordon**, '48, SM '49, whose citation reads: "through his bold leadership, his many inventions, and his innovative entrepreneurial activities, he has been a prime contributor to the growth of electro-technology." . . . Recently elected to the National Academy of Engineering are **Joseph F. Keithly**, '37, SM '38, and **Raymond S. Stata**, '57, SM '58. Keithly is founder of Keithley Instruments in Cleveland, Ohio, and Stata is chair and president of Analog Devices, Inc., in Norwood, Mass. Both Joe and Ray have served on the Department's Visiting Committee. Election to the Academy is among the highest professional distinctions accorded an engineer, and honors important contributions and unusual accomplishments.

Discussion continues about the Department's proposed new 5-year curriculum, to be EECS' primary professional degree program, leading to a new Master of Engineering degree. The plan would call for, among other things, expanding the VI-A Program to financially aid the students enrolled in this curriculum. As Professor Penfield has noted, "it would be accurate to say the VI-A Program served as a model on which the whole mechanical engineering plan was based; VI-A

showed it was possible."

Contact with VI-A alumni, since last writing, has included: a chance meeting with **Steven G. Finn**, '69, SM '69, EE '70, ScD '75, when he was visiting with Professor Shapiro, the associate department head. . . . I had a short visit with Professor **Michael A. Lieberman**, '62, SM '62, PhD '66, of the University of California at Berkeley, when he stopped in to talk with Mr. O'Toole about the VI-A Program. . . . A letter arrived from **Kenneth A. Zeger**, '84, SM '84, telling me that he's joining the EE faculty at the University of Illinois at Urbana, in August 1992, following his stint, from July 1990, at the University of Hawaii at Manoa. . . . I hope you're all enjoying many summer activities!—John Tucker, director (emeritus), VI-A Internship Program, MIT, Room 38-473, Cambridge, MA 02139.

## VII BIOLOGY

**Richard S. Gordon**, PhD '54, sends word from Tempe, Ariz.: "Having reached 65, I have stepped down as director of Arizona State University's NEWCAST Center, but continue as professor of agribusiness. I'm still starting up multi-disciplinary ventures, now harnessing sustainable food production to environmental renewal. My son Jacques Gordon, PhD '87, received a degree from MIT in urban economics (XI). Two free hoods in one family!" . . . **James F. Lenney**, PhD '47, writes: "Mel Jackson and I have discovered a new metabolic reaction leading to the release of a neurotransmitter (GABA) in the human brain and retina." . . . **Rudolf Jaenisch**, Course VII professor at MIT, and **Gerald M. Rubin**, '71, from the University of California at Berkeley, have been elected Fellows in the Cellular and Developmental Biology Section of the American Academy of Arts and Sciences. . . . **Robert A. Weinberg**, '64, PhD '69, Course VII professor and member of the Whitehead Institute for Biomedical Research, is one of seven recipients of the 1992 Gairdner Foundation International Awards, which recognize contributions in medical research. The Gairdner Foundation explains that Weinberg was selected for "elucidating genetic events leading to the development of cancer."

The Association of Alumni and Alumnae has been notified that **Norman I. Gold**, SM '47, PhD '50, of Newton Highlands, Mass., died on March 5, 1987. There was no further information provided.

## VIII PHYSICS

From Great Falls, Va., **Robert E. Zier**, PhD '64, sends word: "I recently joined BDM International in support of BDM's contract with the U.S. Department of Energy's Nuclear Complex Waste Management Program. I am a principal staff member supporting DOE's Office of Technology Development. . . . **Marc Davis**, '69, and **Frank H. Shu**, '63, both of the University of California at Berkeley, and **Ernesto Medina**, PhD '91, of the Instituto Venezolano de Investigaciones Científicas, in Caracas, Venezuela, have been elected Fellows of the American Academy of Arts and Sciences in Cambridge. . . . **John M. Grunsfeld**, '80, senior research fellow in physics at Caltech, has been selected by NASA as one of 19 new astronaut candidates for the Space Shuttle program. According to NASA, Grunsfeld was chosen from 2,054 qualified applicants. Grunsfeld will report to the Johnson Space Center in Houston, Tex., in August 1992 to begin a year of training and evaluation, after which he will receive a technical assignment leading to his selection for a Shuttle flight crew. A specialist in gamma-ray and X-ray astrophysics, Grunsfeld has conducted a wide range of astronomical observations. He has studied compact objects within our own galaxy, the galactic center, high-energy cosmic rays, and solar flares. He is a co-principal investigator on an experiment involving the timing of compact objects and

the search for periodic sources with instruments on the Compton Gamma Ray Observatory, which was launched by the Space Shuttle in 1991. Grunsfeld is currently working with a group of Caltech undergraduates on the design of a NASA Get Away Special, scheduled for launch in the Space Shuttle in 1993, which will measure gamma-ray bursts.

**Dennis E. Overbye**, '66, is the winner of the 1992 American Institute of Physics Science Writing



D.E. Overbye

Award in Physics and Astronomy for his book *Lonely Hearts of the Cosmos* (HarperCollins).

Overbye received a \$3,000 award and an inscribed Windsor chair, along with a certificate. The book "is the story of the most ambitious pursuit in 20th-century science—the quest to understand the universe. Beginning with Hubble's astounding discovery in the 1920s that the universe

is expanding, Overbye chronicles this grand undertaking through the personal stories of some of its major players, including: Allan Sandage, the hand-picked heir of Hubble who fervently carries on the mission to learn the fate of the universe; Stephen Hawking, who after being struck by a debilitating disease, discovers a newfound motivation and becomes one of the world's top theorists on black holes; and Beatrice Tinsley, an outspoken astrophysicist who, as a graduate student, challenges conventional notions about the universe and spends the next 10 years in a bitter feud with Sandage," states an AIP news release. Overbye is a free-lance writer and contributing essayist to *Time* magazine. In 1980, Overbye received the AIP award for an *Omni* article entitled, "The Wizard of Time and Space." In addition to his free-lance work, he was an editor at *Discover* and *Sky and Telescope* magazines and has taught science journalism at New York University.

**Robert J. Papa**, '55, SM '60, employed at the Rome Lab, and **Simon Foner**, senior research scientist and associate director of the Francis Bitter National Magnet Lab, have been elected Fellows of the IEEE. Papa was cited for "contributions to the understanding of electromagnetic scattering and propagation and their applications to radar technology," and Foner for "invention of the vibrating sample magnetometer, contributions to pulsed magnetic field technology, and the development of advanced superconducting materials." Papa has developed extensive computer programs to simulate the detection and tracking of targets in different clutter environments and to evaluate the performance of different radar systems in various environmental scenarios. Currently he is studying the use of polarimetric techniques to minimize the effects of clutter and to determine the effects of small cell size on clutter statistics. He has also developed useful computer simulations of EM wave propagation and scattering from foliage. Foner joined the Magnet Lab in 1961 and has continued research and management in high field physics and technology largely in basic and applied magnetism and superconductivity. In 1986, Foner developed a record 68.4 tesla multi-layer, wire-wound, long-pulsed field magnet which employed a newly developed high-strength, high-conductivity metal-metal matrix microcomposite of Cu and Nb. . . . **Charles L. Glaser**, '77, has published "Nuclear Policy without an Adversary: U.S. Planning for the Post-Soviet Era," in the Spring 1992 issue of *International Security*.

*A Different Sort of Time: The Life of Jerrold R. Zacharias* (MIT Press, 1992) by Jack S. Goldstein has just been published. Zacharias, who joined MIT's Physics Department in 1945, was chair of the faculty in 1962, was named an Institute Professor in 1966, and in 1975 became an Institute Professor Emeritus. According to the book jacket, Goldstein "describes Zacharias's coming of scientific age in



the early 1930s, as a member of I.I. Rabi's group at Columbia, and examines the leading role he played during WW II at MIT's Radiation Lab and at the Manhattan Project."... **Mildred Spiewak Dresselhaus**, MIT Institute Professor, has been awarded an honorary degree from the University of Connecticut. She was one of four women so selected to mark the culmination of a year-long celebration of the 100th anniversary of the admission of women to the university.... Two papers by the late **Bertram E. Warren**, '24, SM '25, ScD '29, have been reprinted in the January 1992 *Journal of the American Ceramic Society* as "two of the best articles ever to appear in the 75-year history of the Journal." The JACS republished the papers to help celebrate its 75th anniversary. Warren was appointed a Course VIII instructor while still a graduate student. He became a full professor in 1939, and became professor emeritus upon his retirement in 1967. He died last year the day before his 89th birthday.... **Leonid Levitov** and **Lisa J. Randall**, both Course VIII assistant professors, have been selected to receive Sloan Research Fellowships by the Alfred P. Sloan Foundation. They are two of the four MIT faculty members selected "on the basis of their exceptional promise to contribute to the advancement of knowledge."

## IX BRAIN AND COGNITIVE SCIENCES

**Donald Wells Pfaff**, PhD '65, of Rockefeller University in New York City, has been elected to the Physiology and Experimental Psychology Section of the American Academy of Arts and Sciences.... Course IX Associate Professor **Michael I. Jordan** has been selected to be the first holder of the 1947 Career Development Professorship. His selection comes in recognition of his "outstanding contributions in education and research." A member of the MIT faculty since 1988, Jordan's research interests are in parallel and distributed processing models of cognitive and linguistic processes; motor control, skill learning; phonetics, phonology, and speech synthesis; nonlinear dynamical systems; and adaptive signal processing.

## X CHEMICAL ENGINEERING

**Stephen Amos Murtha**, SM '74, sends word: "I have recently formed a company, Simulation Tools, Inc., based in West Long Branch, N.J. We provide software tools and services for the Windows and OS/2 environments relating to simulation for process safety management and operator training."... **Mosum E. Tsui**, SM '82, writes: "I recently accepted a position as treasury manager at Blue Cross of California. My responsibilities include



R. Agrawal

overseeing the firm's investment portfolio and asset/liability management."... **Rakesh Agrawal**, ScD '80, is one of six engineering technologists at Air Products and Chemicals, Inc., to receive the Chairman's Award for Excellence. "The six engineers—who collectively hold over 150 U.S. and foreign patents—were recognized for their contributions in creating Air Products' world-class cryogenic technology that today accounts for over a billion dollars annually in worldwide gas process and equipment sales," states a company news release. Agrawal has held various research assignments within Air Products' Corporate Science and Technology Center, and Process Systems Group (PSG). Currently, he is a

senior engineering associate for process cycle development within PSG.... **Ray Harris**, SM '50, reports: "I retired to Hilton Head Island, S.C., with summers spent in York Beach, Maine. I'm very busy as a volunteer for Hospice, Guardian ad Litem (advocate for an abused child in the court system), and drug and alcohol prevention educational program in the schools, etc."... From Houghton, **John Forgive**, SM '50, writes: "I have retired again, this time after a fascinating three-year assignment in Indonesia. Under contract to U.S. AID, I served as the U.S. advisor to the state minister for research and technology and the man primarily responsible for economic development in Indonesia."... **Robert A. Brown**, internationally known for his research and teaching in chemical engineering, has been named the Warren K. Lewis Professor of Chemical Engineering at MIT. Brown is the Course X department head. The chair was named for the first head of the Department of Chemical Engineering, a man considered the founder of modern chemical engineering, who died in 1975 at the age of 92. The department was the first of its kind in the United States. Brown, who specializes in fluid mechanics and transport processes, is also an authority on the use of supercomputers to solve complex engineering problems in chemical engineering. In 1991 Brown was named one of the youngest engineers to be elected to the National Academy of Engineering. He joined the MIT faculty in 1980 and in that year, and again in 1983, 1985, and 1988, the students of his department presented him with its Outstanding Faculty Award. In 1985 he received the MIT Graduate Student Council Teaching Award.... **George Stephanopoulos**, a chemical engineer noted for his teaching and in research process and product design and development, has been selected to be the next Arthur Dehon Little Professor at MIT. The chair was established in 1986 by Arthur D. Little, Inc., and Royal Little to honor the founder of the company and to celebrate its centennial. Stephanopoulos, a member of the MIT faculty since 1984, directs the Laboratory for Intelligent Systems in Process Engineering. Since 1989 he has been a Leaders for Manufacturing Professor of Chemical Engineering, an appointment recognizing his interaction with industry engineers and scientists on processing systems. His teaching and research has involved process analysis, design and optimization theory, design of process control systems, planning and scheduling of process operations, design of integrated industrial complexes, and interaction between design and operations. His most recent work has focused on using computer science and technology for the reformulation and expanded solution of problems in process engineering.... **Robert S. Langer, Jr.**, ScD '74, a Course X professor, has received the Charles M.S. Stine Award in Materials Engineering and Science from the American Institute of Chemical Engineers. The award recognizes outstanding service to the materials community and carries a certificate and honorarium.

**Duncan W. MacLeod**, SM '50, of Kennebunk, Maine, died on January 19, 1992. He was a veteran of WW II and was employed as a chemist for Goodyear Tire and Rubber Co.

## XI URBAN STUDIES AND PLANNING

**Alexander Jaegerman**, MCP '81, writes: "I will be a Loeb Fellow in Environmental Design at Harvard Graduate School of Design in 1992-93."... **Yu Hung Hong**, MCP '89, a Course XI graduate student at MIT, has been selected a MacArthur Scholar for the summer of 1992 and the 1992-93 academic year. He is one of 16 graduate students chosen. Under a grant from the John D. and Catherine T. MacArthur Foundation, the Center for International Studies provides funds for graduate students engaged in international peace and security studies at MIT.... **Toby Kramer**, SM '91, has recently been hired as a technical assistant for the Winchester Housing Partnership Board (HPB) in

Winchester, Mass. The HPB will be formulating a comprehensive housing affordability strategy over the next several months, with the goal of bringing affordable housing to the Winchester community.... Course XI Professor **Phillip L. Clay**, PhD '75, widely known for his work in housing policy and in community-based development and employment, was named department head in July. Clay, who has been associate department head for two years and also director of the Masters in City Planning Program, will succeed Professor **Donald A. Schön**. Clay's current research, which is sponsored by several national foundations, evaluates the effectiveness of various initiatives to build organizational and development capacity in community-based development organizations and to connect social goals such as youth development to these efforts.

## XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES



M.A. Sneeringer

**Mark A. Sneeringer**, '76, PhD '82, has joined the GE R&D Center as a manager of Remediation Vendor Development Programs. Sneeringer worked for GE Superabrasives in Worthington, Ohio, as senior development engineer from 1982-85, as function manager of its Irish facility from 1985-87, and as R&D manager from 1987-92. He is a member of the Materials Research

Society.... **Donald Weidner**, PhD '72, is director of the Center for High Pressure Research at the State University of New York at Stony Brook. The university had a new seismic station set up just in time to observe a tremor measuring 2.8 on the Richter scale. The tremor occurred March 10 along a fault line that runs near Block Island. Weidner considers the monitoring of earthquakes to be just one of the many missions of the new station. It is part of an educational program to teach students from kindergarten through the undergraduate level about the forces deep within the Earth that shape such surface events as earthquakes and volcanoes.... **Jack Wisdom**, Course XII professor at MIT, and **John Armistead Wood**, PhD '58 of Harvard University, have been elected Fellows in the Astronomy & Earth Sciences Section of the American Academy of Arts and Sciences.

**George A. Thompson**, SM '42, professor of geophysics at Stanford University in California, has been elected to membership in the National Academy of Sciences. Thomas has played a leading role in the earth sciences, both at Stanford and nationally. His research has focused on how processes in the Earth's deep crust and mantle produce large-scale geologic features, including major mountain ranges, high plateaus, and rift valleys.

Associate Professor **John C. Marshall** has been named the Cecil and Ida Green Career Development Professor in Course XII. Marshall, a physical oceanographer, joined the faculty in July 1991, after spending seven years teaching in the Department of Physics at Imperial College in England. He is presently on leave from his appointment at London University where he is a Reader in Physics. Marshall is known for his work in modelling the large-scale oceanic circulation and in analyzing both theory and observations of the persistent structures in the atmosphere. His research has focused on the interaction between geostrophic turbulence in the atmosphere and ocean and its influence on large-scale flows. Geostrophic turbulence is linked to the earth's rotation. In recent years he has been studying convective elements of the ocean circulation and the deep circulation.



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Kenneth L. Recker, SM '73  
Mark X. Haley, SM '75  
Robin B. Dill, '77  
Andrew F. McKown, SM '78  
Keith E. Johnson, SM '80  
Elliott I. Steinberg, SM '80  
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## XIII OCEAN ENGINEERING

Mark D. Lipsey, SM '78 (III), OCE '78, writes: "After an interesting year including the Gulf War and the Mt. Pinatubo volcano eruption in Subic Bay in the Philippines, I retired from the U.S. Navy and am the director of engineering at the JW Marriott Hotel in Hong Kong." ... From Belmont, Mass., Commander **Albert F. Suchy**, SM '80, OCE '80, reports: "I am finishing my first year as commanding officer of Coast Guard's Naval Engineering Support Unit in Boston. By the summer of 1992 the family should even catch up to me and we'll be living together after spending the last 5 years geographically separated. Our unit has been challenged, including engineering a major shaft realignment on a medium endurance cutter, repairing a propulsion shaft bearing on a buoy tender, and managing numerous routine drydock repair contracts. I'll get over to see everybody at the Institute soon." ... **Raphael L. Vermeir**, SM '79, reports: "I have moved to London to become general manager of strategic planning and business development for Conoco Refining and Marketing in Europe." ... From Edmond, Okla., **Lanny Benham**, SM '77, sends word: "I am senior VP of The Benham Group, a registered professional engineering company in eight states. I was recently selected as captain in the U.S. Naval Reserve. I'm currently serving as commanding officer of Mobile Inshore Undersea Warfare Unit 113. I am a member of the board of directors of The Benham Companies and Roberts-Schornick & Associates (RSA). RSA is a full service environmental company specializing in hazardous waste remedial design and compliance activities." ... **David E. Guza**, SM '88, reports: "I am currently employed by the Battelle Memorial Institute as a research engineer specializing in mechanical and ocean engineering R&D. I have also been extracurricularly involved with the control surface design of Battelle's entry into the International Human-Powered Submarine races last June." ... **Richard Byrnes**, SM '89, sends word: "I have been a consultant with Booz, Allen & Hamilton's Maritime Transportation Practice for almost three years now. My recent work has been helping with privatization of Mexico's national port system. I am also recently engaged to Sara Strayer." ... **George Rodgers**, NE '55, writes: "Warm regards to all our buddies of the mid-50s; Marilyn and I moved down to Fairfax, Va., from GD/EB about 25 years ago. (Who said I can't anticipate a RIF in the works?) Some of Marilyn's fondest memories are of the MIT wives club activities over those marvelous/sweating three years. The S&T work in the Capital area has evolved from busy governmental paper shuffling then to a fairly respectable effort now in many corporate groups and elsewhere; I find it quite stimulating even if much is as our former companero-classmate opined, 'Pooliteeks!' We have a local IEEE effort to experiment with advanced math in secondary school, now in its third semester, and looking for classroom applications via volunteer lecturers. We have about 30 IEEE lecturers on our roster now, some from MIT alumni/ae, and we visit the classroom-shrines of Professors Gardner and Reintjes, *Matrices*, *Fourier and Laplace Transforms*, and then on to Wiener, Hildebrand, and Y.W. Lee's *Probability and Statistics*. We have one continuous theory guy who sits throughout the 16 weeks, and each of the five topics extends for several weeks with follow-up applications from around Route 128, the Beltway in industry or labs. As your local newspaper can tell you, many people come to Washington, few people leave it....we have many former students from MIT locally who might like to join us in this experiment. Your assignment, should you choose to accept it, is to hold forth in class twice a year for 2 hours, telling these eager faces a thrilling story of 'Science & Technology in the Workplace'; that's the title of this avocation. Don't wait, rush to your local payphone and dial 703-591-4357, for the opportunity to continue to do something for your country. Meanwhile, enjoy!" ... Course XIII Assistant Professor J.

**Robert Fricke**, PhD '91, has been named to the 1992 Doherty Career Development Professorship in Ocean Utilization by the MIT Sea Grant College Program. Fricke joined the department in 1990. His research interest is in using ocean acoustics to explore the underside of sea ice. He will use the fellowship to develop instrumentation for under-ice exploration with an autonomous underwater vehicle. This will involve calibrating existing instrumentation for under-ice conditions and developing prototypes for deployment in the Arctic. The Doherty Professorship, endowed by the Henry L. and Grace Doherty Charitable Foundation, encourages promising, non-tenured professors to undertake marine-related research that will further innovative uses of the ocean's resources. Every year the program selects one or two new faculty for an award of \$25,000 per year.

The Association of Alumni and Alumnae has been notified that Captain **Herbert J. Pfingstag**, SM '32, died on June 11, 1983. There was no further information provided.

## XIV ECONOMICS

From Bethesda, Md., **Margaret Garritsen de Vries**, PhD '46, writes: "My husband, **Barend A. de Vries**, PhD '51, and I celebrated our fortieth wedding anniversary last April 5. By incredible coincidence, the young woman who assisted our caterer was also a recent graduate of MIT (Sloan School of Management)." ... **Juan Antonio Poblete**, SM '69, is a professor at Universidad Gabriela Mistral and president of a consulting firm in Santiago, Chile. ... **Avinash Dixit**, PhD '68, at Princeton University, **Peter Carl Ordeshook**, '64, at Caltech, **Howard Lewis Rosenthal**, '60, PhD '64, at Carnegie-Mellon University, and Course XIV Professor **Paul R. Krugman**, PhD '77, at MIT, have been elected Fellows of the American Academy of Arts and Sciences. ... **A. Denny Ellerman**, a leading energy economist, has been named executive director of MIT's Center for Energy and Environmental Policy Research (CEEPR), a shared activity of the Department of Economics, the Energy Lab, and the Sloan School of Management. Ellerman will also serve as a senior lecturer in the Sloan School. Since its founding in 1976, the CEEPR has been the focus of research on energy markets and policies at MIT and an international forum for the examination of policy alternatives. In recent years, the CEEPR's research, which is mainly industry-sponsored, has been increasingly concerned with environmental policies related to energy production and use. Ellerman has served on the staffs of the National Security Council, the Energy R&D Administration, and the Office of Management and Budget. Most recently, he has been a VP at Charles River Associates, a firm of consulting engineers.

## XV MANAGEMENT

**Steve Pearse**, SM '82, writes: "I'm still in Kansas City, running Sprint's Data Operations (which, fortunately, is growing like gangbusters)." ... **Lydia H. Dane**, SM '85, reports: "I'm teaching in the business school at the University of South Carolina at Aiken, and I find it challenging and rewarding. And living on a farm in a community of 1,000 people is very laid back. A traffic jam is a car coming the other way. Very easy on the cholesterol!" ... **James W. Sawhill**, SM '89, sends word: "I am currently living in Walnut Creek, Calif., with my wife, Laurel, and son, John (almost 2). Recently I changed jobs—I'm now a VP in the Corporate Planning Group at Wells Fargo Bank." ... **Greg Carter**, SM '85 and **Elizabeth Carter**, SM '85, write: "Jack Carter, who was born November 11, 1991, is well on his 'weight' to becoming a sumo wrestler. Liz has a new job as a manager of professional services for Mast Industries (Far East). She is in charge of training and development programs for Hong Kong,



Korea, Taiwan, Singapore, Jakarta, and Sri Lanka." ... From Boston, Mass., **Michael A. Connolly**, SM '82, reports: "With my AIDS Action colleague, Bob Rimer, I have written a book entitled *HIV+: Working the System*, which Alyson Press will be publishing in December. The book is a humorous, first-person account of Bob's successful medical, legal, and financial strategies, intended for people concerned about HIV."

**Brian Silverman**, SM '90, writes from San Francisco: "I earned a master's degree in economics last June on the way towards a PhD in business. I worked in the Tsongas campaign in Northern California; hit up Sloan alumni/ae in the Bay Area for contributions (thanks guys!)..." From Glendale, Calif., **Michael Shaughnessy**, SM '79, sends word: "After three exhilarating and exhausting years in television production, I've joined The Seybold Companies, a firm whose primary focus is the application of digital technology across all manner of communications media—print, film, video, audio, and electronic. And based in Malibu!! K.D., my spouse, recently joined Nestle's U.S. headquarters as an internal compensation consultant. Our daughters, Kate, 7, and Kendra, 5, are thriving." ... **Timothy C. Fredel**, SM '85, reports: "I've recently started my own consulting firm, Indigo Systems, focused on helping companies implement a systemic view of product development, quality programs, and product transitions." ... **Phee Boon Kang**, SM '75, business manager and VP at Citibank, writes: "I was reassigned by Citibank to head the retail banking business for its Taiwan branches in January 1992. Prior to that, I spent four years in Japan and expanded Citibank's retail banking network there from 6 to 18 branches." ... **Ronald M. Weiers**, SM '65, writes: "I'm teaching college for the 25th year; have 3 kids through college, 2 to go. I just published my 2nd textbook, *Introduction to Business Statistics* (Dryden Press). I'm living in Jimmy Stewart's hometown, Indiana, Pa. Best wishes to all."

**Sharon Lee-Terry**, SM '83, reports: "I married a wonderful man, George Terry, in November 1990. After which we had a commuter marriage until 1992 when I resigned from my position at Analog Devices to move to Ridgefield, Conn. With the current market, I am currently seeking employment in the Westchester, N.Y., or Fairfield, Conn., counties. I would love to hear from all of you in the class of '83." ... **Steve Grossman**, SM '69, is executive director of the Ohio Water Development Authority in Columbus, Ohio. He writes: "I'm currently serving as president of the Council of Infrastructure Financing Authorities; a national organization of state and local agencies that have authority to assist and facilitate the issuance of debt financing for public infrastructure purposes. The organization is dedicated exclusively to the service and representation of public environmental financing authorities." ... Karen Lee, better known as Klee, got married in June 1991, and is now living by the name **Karen Lee Lynskey**, SM '91. She still resides in Boston and works for CSC Index. ... From London, **Adam M. de Sola Pool**, SM '88, writes: "Last January I joined the European Bank for Reconstruction and Development. It is fun joining a start-up—especially when one starts with 10 billion ECU. Right now I'm building a glass and a TV plant in Eastern Europe. Hope to see classmates in London."

**Major Pat Leake**, SM '84, writes: "Michele and I are proud to announce the birth of our sixth child, Evan Joseph, born December 13, 1991, in Kansas City. We now have four girls and two boys ranging in ages from 8 months to 11 years. We arrived back in Kansas last summer from Fort Hood, Tex., where I completed my assignments as operations officer and executive officer of the 17th Engineer Battalion in the 2nd Armored Division. I am now teaching a warfighting tactics seminar at the Center for Army Tactics in the U.S. Army Command and General Staff College in Fort Leavenworth, Kans." ... **Gordon C. Shaw**, SM '60, reports: "I'm still professor of management science in the Faculty of Administrative Studies at York University in North York, Ontario. I'm also president of Muskoka Lakes Nav-

igation and Hotel Co., Ltd., operators of the RMS *Seawan*, for the Muskoka Lakes—last of the coal-fired inland lakes steam boats in North America." ... Rear Admiral **W.G. Jerry Ellis**, SM '74, sends word: "I'm currently a rear admiral in the U.S. Navy serving as the deputy assistant secretary for military application in the Department of Energy." ... **Tetsu Serizawa**, SM '85, reports: "After spending nine years in the U.S., I'm now back in Tokyo working for Bankers Trust as VP in charge of derivative products marketing. Our family misses BBQs in the backyard of our Connecticut house, but the business is exciting here. Please make sure to call if anyone comes to Tokyo."

**Alejandro Sosa-De-Boutaud**, SM '70, sends word from Panama: "I sold the family liquor business to Bacardi and I continue to work with them. My wife, Rita, and I, and our son Alex, would love to hear from all Sloan friends. You can visit, too!" ... **David R. Mannheim**, SM '88, and **Toni Y. Shimura**, SM '81, have been promoted to VPs at the Massachusetts Financial Services Co. Prior to this, they each served as assistant VPs at the Boston-based firm. ... **Richard S. Bodman**, SM '61, senior VP for corporate strategy, development, and intellectual property at the American Telephone & Telegraph Corp. in Basking Ridge, N.J., has been named to the board of directors at Tyco Labs, Inc., in Exeter, N.H. ... **George Phillips**, SM '54, is president of the Funk & Wagnall's Corp. in Mahwah, N.J. He was group VP at MacMillan, Inc., in New



**E.I. Glickman**

York City previously. ... **Ernest I. Glickman**, SM '64, president of Harbridge House, Inc., an international management consulting firm headquartered in Boston, was elected CEO by the company's stockholders. Glickman's election from COO, the position he held with the presidency prior to this, culminates a 25-year career with the firm. As CEO, Glickman serves on the board of directors and is responsible for all of the operations of the firm. In addition, he will continue to be actively involved in providing strategic planning consulting services and executive development to the financial services industry and to other corporate clients among the Fortune 250. Glickman has served as a member of the Sloan School's Continuing Education Task Force.

**A. Denny Ellerman**, a leading energy economist, has been named executive director of MIT's Center for Energy and Environmental Policy Research (CEEPR), a shared activity of the Department of Economics, the Energy Lab, and the Sloan School of Management. Ellerman will also serve as a senior lecturer in the Sloan School. Since its founding in 1976, the CEEPR has been the focus of research on energy markets and policies at MIT and an international forum for the examination of policy alternatives. In recent years, the CEEPR's research, which is mainly industry-sponsored, has been increasingly concerned with environmental policies related to energy production and use. Ellerman has served on the staffs of the National Security Council, the Energy R&D Administration, and the Office of Management and Budget. Most recently, he has been a VP at Charles River Associates, a firm of consulting engineers. ... **Andrew W. Lo**, associate professor of finance at Sloan, is one of four MIT faculty members selected to receive Sloan Research Fellowships by the Alfred P. Sloan Foundation. They were selected on the basis of their exceptional promise to contribute to the advancement of knowledge.

#### Sloan Fellows

**Kermit Campbell**, SM '77, has been named president of Herman Miller, Inc., in Zeeland, Mich. Previously, he was group VP at Dow Corning Group

in Midland, Mich. ... **Donald V. Fites**, SM '71, chair and CEO at Caterpillar, Inc., in Peoria, Ill., has been named to the board of directors of the Georgia-Pacific Corp. in Atlanta, Ga.

The Association of Alumni and Alumnae has been notified of the following deaths: **Frans J. L. De Hertogh**, SM '84, of Belgium, on March 21, 1992, a year after he underwent brain surgery, and **Leonard H. Edwards**, SM '64, of Cincinnati, Ohio, on March 26, 1991. There was no further information provided.

#### Senior Executives

**Hiroo Yamashita**, '89, is general manager in the Energy & Industry Group at Mitsubishi Electric Corp. in Tokyo. ... Promoted to new positions within their companies are: **Vance D. Coffman**, '87, from President of the Space Systems Division at Lockheed Missiles & Space Co., in Sunnyvale, Calif., to corporate executive VP of the Lockheed Corp., in Calabas, Calif.; and **Robert J. Furnas**, '84, from manager of industrial relations to VP and manager of personnel and industrial relations at



**M.T. Antone**

Westvaco Corp. in New York City. ... **Sister M. Therese Antone**, '89, VP for institutional advancement at Salve Regina University in Woonsocket, R.I., has been named the recipient of the 1992 Mercy Higher Education Colloquium Leadership Award. MHEC, a national organization established by the Sisters of Mercy to foster and encourage scholarship, innovation, and diversity, strives to develop the unique potential of its members within the field of higher education. The leadership award is granted annually to a Sister of Mercy who has made important contributions to advance the goals and mission of MHEC. An expert in the field of institutional advancement, Antone serves on several national and local education organizations.

The Association of Alumni and Alumnae has been notified that **Lovett R. Smith, Jr.**, '57, of Danbury, Conn., died on April 17, 1991. There was no further information provided.

#### Management of Technology Program

**Anthony F. Purdie**, SM '86, is now director at Northern Regional Health Authority in the United Kingdom. ... **Glenn E. Nedwin**, SM '87, is president of Novo Nordisk Biotech, Inc., in California. Glenn and Julie's triplet daughters are now 4 years old.

Commander **Tom Gardner**, SM '88, is now in charge of R&D of appropriation for the U.S. Navy and will be in command of a submarine during the summer of 1992. Regrettably, Tom and Jane have reported the death of their 8-year-old son, Allen, after a long illness.

**Meir Zucker**, SM '89, is sales and marketing manager of entry level systems at Optrotech, Inc., in Billerica, Mass. ... **Julie Fernane Joyce**, SM '91, is now manager of network development at Enterprise Lan Communications at IBM in Research Triangle Park, N.C.

**Paul Hunter**, SM '91, is director for technology deployment/transport at Bell Atlantic. He let us know that classmate **Pete Dunbeck**, SM '79 (XVI), SM '91, visited Washington, D.C., for COMNET 92, and was able to have dinner with the Hunters one evening. On another evening, they visited with another classmate, **Mark Emery**, SM '91. Paul extends an open invitation to any class members visiting the Washington, D.C., area. ... **Steve C. Laughton**, SM '91, has a position with DBS Venture Investments in Singapore.—Fay Wallstrom, Management of Technology Program, MIT, E56-304, Cambridge, MA 02139.



## XVI AERONAUTICS AND ASTRONAUTICS

**James F. Glass**, SM '75, writes: "I'm currently a senior staff member in the Systems Architecture Department of the Rocketdyne Division at Rockwell International. I'm working on the Space Exploration Initiative (SEI)—nuclear thermal rockets and lunar exploration vehicles."

From Los Angeles, **Stan Rosen**, SM '70, sends word: "I was elected to the board of directors of the National Space Society. I am completing a term as VP for public policy with the AIAA. **Paul Koon Yiu Chan**, SM '91, is working as a research manager at Koneman Capital Management, a fund management shop in Singapore."

Astronaut **Byron K. Lichtenberg**, SM '75, SCd '79, was a member of the crew that flew in March launching of the space shuttle *Atlantis*. During the eight-day mission, Lichtenberg, as the crew's payload specialist, studied the sun and the Earth's atmosphere from space. He carried two items of note aboard the shuttle—a small piece of the steps of Lobby 7 and a 10-foot long banner signed by faculty, students, and staff members.



**S.J. Schneider**

**Steven J. Schneider**, SM '73, EAA '75, an aerospace engineer at the NASA Lewis Research Center, has been named a recipient of the 1991 Lewis Distinguished Publication Award. The Distinguished Publication, "Spectrally Resolved Rayleigh Scattering Diagnostic for Hydrogen-Oxygen Rocket Plume Studies," discusses a new method for measurement of gas

temperature, density, and velocity based on the scattering of laser light from molecules. These measurements are used to verify the accuracy of computer codes used to predict the performance of new rocket designs. Schneider, who works in the Low Thrust Propulsion Branch at Lewis, is currently leading a team of employees on low thrust chemical propulsion research.

**John W. Leech**, SM '57, PhD '67, senior industrial liaison officer for the Industrial Liaison Program, has been elected to the board of trustees of the AIPE (American Institute of Plant Engineers) Foundation. The trustees oversee the day-to-day operations of the foundation, which currently is working on the development of a new seminar series and educational and research activities. The AIPE is the leading information and education network for facilities engineering managers.

Commander **William T. Wootton** (ret.), SM '53, of Santee, Calif., died on June 1, 1991. Wootton served on a number of U.S. Navy ships during his career as a line officer, the first being the cruiser *USS San Juan*. He was the commanding officer of the radar picket ship, *USS Tracer*, homeported in San Francisco. Following his retirement from the Navy in 1963, Wootton joined the faculty of California State Polytechnic University in Pomona as a professor of electrical engineering. Following his retirement from the university, he continued to teach during the winter quarter each year. He coached the Claremont Colleges club lacrosse team for 8 years in the 1970s.

Reverend **Leo W. Welch**, SM '39 (SJ), of the Philippines, died on June 28, 1990. He taught at Ateneo de Manila in 1932 and 1946-49, at San Jose Seminary from 1943-44, at Sacred Heart Novitiate from 1949-55, at Ateneo de Davao from 1955-60, and finally at Xavier University from 1960-68 and 1976-78, where he was a professor of physics. He spent a number of years as a missionary priest in Bukidnon.

## XVII POLITICAL SCIENCE

**Peter Haas**, PhD '86, writes: "I received tenure and was promoted to associate professor at the University of Massachusetts at Amherst. Next year I will be on leave, with a German Marshall Fund Fellowship and a grant from the National Science Foundation, to work on a book on the dynamics of international environmental cooperation. I just completed editing a book with Robert Keohane and Marc Levy, on international environmental institutions, to come out in 1993 with MIT Press as *Institutions for the Earth: Sources of Effective International Environmental Protection*. I edited the winter 1992 issue of *International Organization* on "Knowledge Power and International Policy Coordination." ... **Dana G. Mead**, PhD '67, has been named COO at Tenneco, Inc., in Houston, Tex. Previously, he was executive VP at International Paper Co. in Purchase, N.Y. ... **John David Steinbruner**, PhD '68, of the Brookings Institution in Washington, D.C., has been elected a Fellow in the Public Affairs and Business Administration Section of the American Academy of Arts and Sciences. ... **Paul R. Josephson**, PhD '87, has written *Physics and Politics in Revolutionary Russia* (University of California Press, 1991). The jacket sleeve describes the book as "a history of science under stress. The book describes the development of the physics discipline in Russia from the turn of the century until WW II." Josephson teaches in the Science, Technology, and Society Department at Sarah Lawrence College in Bronxville, N.Y. His research for the book spanned three long-term visits to the USSR. His current work focuses on the relationship between modern science, technology, ideology, and the state. ... **David P. Jeffrey**, a Course XVII graduate student at MIT, has been selected a MacArthur Scholar for the summer of 1992 and the 1992-93 academic year. He is one of 16 graduate students chosen. Under a grant from the John D. and Catherine T. MacArthur Foundation, the Center for International Studies provides funds for graduate students engaged in international peace and security studies at MIT.



**H.E. Wolpe**

Michigan Congressman **Howard E. Wolpe**, PhD '67, received an honorary doctor of public service degree from Western Michigan University in Kalamazoo, Mich., at its June commencement exercises. Wolpe was a former WMU faculty member, joining the faculty in 1967 to teach political science. For 10 years, Wolpe served as chair of the House Africa Subcommittee on the Foreign Affairs Committee where he became one of the leading congressional opponents of apartheid. After serving for six years on the House Budget Committee, he is now a member of the House Science, Space, and Technology Committee. As chair of its Investigations and Oversight Subcommittee, he has focused his efforts on environmental protection, energy, and R&D. Wolpe will not be running for reelection, as redistricting has eliminated his seat. In keeping with a pledge to not accept a congressional pay raise until an election has intervened, Wolpe has donated three salary increases to WMU. The first two amounted to more than \$20,000 and created the Howard Wolpe Fund for the Study of Politics, which provides scholarships to WMU students. He gave his third increase to the University's Institute for the Study of Race and Ethnic Relations. ... The Carnegie Corp. of New York has awarded a \$1.2 million, three-year grant in renewing its support for the MIT Defense and Arms Control Studies (DACS) Program. The corporation also announced a separate grant of \$150,000 to support a study of nuclear arms control in the Middle East. The study is linked administratively to the DACS Program, which is part of the Center for International Studies.

## XVIII MATHEMATICS

**Edmund F.A. Kelly**, PhD '70, has been named president and CEO for Liberty Mutual Insurance Co. in Boston, Mass. Previously, he was president of the Employee Benefits Division at Aetna Life & Casualty Insurance Co. in Hartford, Conn. ... **William S. Spangler**, '86, has been awarded a "Boss" Kettering Award by the General Motors Corp. for taking part in the invention of an "expert system which assists engineers in designing experiments and in statistically analyzing the test data." Named for GM's late VP and inventor, Charles F. Kettering, who himself held more than 140 patents, the award encourages, recognizes, and rewards GM inventors for technical creativity and leadership. Along with a trophy, each winner also receives a monetary stipend. ... **Robert MacPherson**, a Course XVIII professor, has been elected a Fellow of the Mathematics Section of the American Academy of Arts and Sciences. ... MIT Professor of Mathematics, **Richard B. Melrose**, has been named one this year's 149 Guggenheim Fellows. He was granted the award for his work on the analysis and geometry of manifolds with corners. ... **Sheldon Chang**, assistant professor of mathematics, has been selected to receive a Sloan Research Fellowship by the Alfred P. Sloan Foundation. He was selected on the basis of his exceptional promise to contribute to the advancement of knowledge.

**Maynard S. Renner**, '42, of Groton, Mass., died on December 31, 1991. He worked as a research chemist for Dewey Almy Co., (now W.R. Grace) from 1926 until his retirement in 1970. Maynard was a member of the ACS, a past president of the Groton Historical Society, and a member of the Groton Housing Authority. He also belonged to several other town organizations, including the Groton Republican Town Committee.

## XX APPLIED BIOLOGICAL SCIENCES



**S.W. Drew**

From Holtwood, Pa., **Harmon L. Liebman**, SM '54, writes: "Last fall it was our pleasure to see **Joe Stern**, '49, SM '50, PhD '53, after some 25 years of non-meeting paths. Joe turned out to be the chair of the Bio-netics Corp. and (as he always was remembered), was his usual gracious and interesting self." ... **Stephen W. Drew**, PhD '74, has been named VP for Technical Operations and Engineering for Chemical Manufacturing in the Merck Manufacturing Division (MMD). MMD is a division of Merck & Co., Inc., a prescription drug company. Drew, who joined the company in 1980, will be responsible for manufacturing technology encompassing several fields in chemistry, biology, and engineering.

## XXI HUMANITIES

**Nicholas D. Ostler**, PhD '79, writes: "In June 1991, I founded my own company, Linguacubon, Ltd. I became coordinator of the U.K. government program of support for research in speech and language technology. ... **Henry Jenkins**, assistant professor of literature, has been given the 1992 Harold E. Edgerton Award. Jenkins is widely regarded as a leader and founder of a new area of scholarship centered on the relation between the narrative arts of the mass media and their audi-



ences. He accords audiences a more active role in the creative process than previous researchers, for example showing how Star Trek fans have appropriated the program materials to create their own underground literature surrounding the series. He also is a film scholar specializing in movie comedy in the early sound era. The award, which carries an honorarium of \$5,000, was established in 1983 with contributions made by the faculty in honor of Harold E. "Doc" Edgerton, '27, who died in 1990. It recognizes distinction in teaching, research, and service to the MIT community by a junior faculty member.

**George Stephen Boolos**, PhD '21, and **Robert Stalnaker**, professors of linguistics and philosophy at MIT, and **Arnold Zwicky**, PhD '65, of Ohio State University in Columbus, Ohio, have been elected Fellows in the Humanities Class of the American Academy of Arts and Sciences.

**Seth Racusen**, '74, a political science graduate student, is one of 16 students who have been selected as a MacArthur Scholar for the summer of 1992 and the 1992-93 academic year. Under a grant from the John D. and Catherine T. MacArthur Foundation, the Center for International Studies provides funds for graduate students engaged in international peace and security studies at MIT. . . .

**Robin Kilson**, assistant professor of history at MIT, will be one of 24 Pew Faculty Fellows at the Kennedy School of Government at Harvard next year. The Fellowships were established to enhance education in international affairs by encouraging faculty members to use case method instruction in their course.

**Noam Chomsky**, Institute Professor, spoke on "Force and Opinion: The New World Order at Home and Abroad," at the Maine Center for the Arts on the University of Maine campus. He received an honorary doctorate of humane letters from UM during his visit to the campus. One of his lectures also appears on the flip side of a rock group's recording. During the Gulf War, the publication *Maximum Rock and Roll* asked Chomsky to tape-record one of his talks as part of a project on differing political viewpoints. He agreed, and now the 15-minute recording is on the back side of the 45-rpm record, "New World Order," by the rock band Bad Religion.

## XXII NUCLEAR ENGINEERING

**Ioannis A. Papazoglou**, SM '74, ScD '78, writes: "In July 1989, I was appointed director of the Institute of Nuclear Technology-Radiation Protection of the National Center for Scientific Research 'Demokritos' in Athens, Greece. The Institute of Nuclear Technology-Radiation Protection is addressing R&D problems in selected topics in the following four areas: radiation protection, nuclear analysis techniques, industrial safety, and mass and energy transfer. . . . **Richard M. Banister**, SM '71, reports: "I am currently serving as manager of geothermal operations for Mission Energy Co., in Irvine, Calif. Mission is an affiliate of Southern California Edison and holds equity positions in seven operating geothermal power plant projects. . . . Word from **Shivaji S. Seth**, SM '67, ScD '70: "As group leader for Nuclear Systems, I continue to be responsible for Mitre's technical support to the U.S. NRC and the Defense Nuclear Facilities Safety Board (DNFSB). Currently we are looking for additional experienced nuclear professionals. I look forward to hearing from MIT alumni/ae. . . . From Carlsbad, N.M., **Chuan-Fu Wu**, PhD '88, sends word: "I work at the Westinghouse Waste Isolation Division as manager of Dosimetry and Analytical Technology. I am a certified health physicist by the American Board of Health Physics. I was a founder and am the 1992 chair of the American Nuclear Society's Carlsbad Section, and am included in the eighth edition of *Who's Who in Engineering*, 1991."

**Mario P. Fiori**, SM '66, NUE '66, PhD '69, writes from Vienna, Va.: "After two years in my consulting business, I joined DOE and am the Secretary of

Energy's representative to the Defense Nuclear Facilities Safety Board. I would enjoy hearing from my Nuclear Engineering Department classmates!" . . . **Neil E. Todreas**, ScD '66, a nuclear engineer recognized internationally for his leadership in thermal-hydraulic design and reactor power safety, has been named the first KEPSCO Professor of Nuclear Engineering at MIT. KEPSCO—the Korea Electric Power Co.—established the professorship with a \$2-million endowment to support teaching and research in nuclear engineering and as a means of exchanging scientific and intellectual knowledge in this field with MIT. Todreas has been a member of the department since 1970. From 1981-89, when he was head of the department, he initiated the department's thrust in the development of second-generation fission reactor concepts. Currently, together with Professor Michael Driscoll and students, he is developing a light water reactor concept based on passive safety characteristics. The concept does not require the injection of emergency coolant in the most severe design accident. From 1958 until he joined the MIT faculty, except for his graduate years, he was a reactor engineer with the U.S. Atomic Energy Commission. There he worked on the prototype versions of current reactor plants.

## TPP TECHNOLOGY AND POLICY PROGRAM

**David W. Cheney**, SM '83, is a senior associate with the private sector Council on Competitiveness (not to be confused with the council of the same name chaired by Vice-President Quayle). He and his wife, Alexandra Fairfield, are the proud parents of Alexander Ward Cheney, born February 6, 1992. . . . **Chitru S. Fernando**, SM '86, has been involved in two interesting projects during the past 18 months. First, working with Paul Kleindorfer at the Wharton School of Business, he was successful in attracting World Bank funding for a Wharton research project on "Financing and Institutional Mechanisms for CFC Abatement in Developing Countries." Second, he has been working in the U.K. on an interesting set of pricing and institutional issues associated with the privatization of the electricity sector in England and Wales. And, as of July 1992, he is joining the faculty at the Freeman School of Business at Tulane University as an assistant professor of finance. . . . **Richard Byrnes**, SM '89, has been a consultant with Booz, Allen & Hamilton's Maritime Transportation Practice for two and a half years now. His recent work has been helpful with privatization of Mexico's National Port System. He is also recently engaged to Sara Strayer. . . . **Hossein Mohsenzadeh**, SM '90, has started his own risk management software and consulting company in London named Riskware Financial Systems. . . . **Paul Koon Yiu Chan**, SM '91, is currently working as a research manager in a fund management shop in Singapore. . . . **James Moses**, SM '91, has joined the engineering staff at Northern Telecom, Inc., in Research Triangle Park, N.C. . . . **Damon Wells**, SM '91, is a program analyst at the Department of Transportation. He handles all launch policy issues related to the Far East.—**Richard de Neufville**, Technology and Policy Program, MIT, Room E40-252, Cambridge, MA 02139.

## STS PROGRAM IN SCIENCE, TECHNOLOGY & SOCIETY

Professor **Leo Marx** lectured on "The Environment and the Two Cultures," at Colby College in April. He was keynote speaker at an April conference on American Studies and the Curriculum. . . . Professor **Meritt Roe Smith** spoke at the Yale-Smithsonian Seminar on Material Culture in New Haven on May 1. His talk was entitled "Firearms and American Industrialization 1795-1976." . . . Professor **Sherry Turkle** spoke on "Computers and the Culture of Simulation" at the Art Futura Conference in Barcelona, Spain, last April. Later that

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month she gave a talk on the MIT Athena Project at Cornell University. . . . Professor **Charles Weiner** gave five lectures on the recent social and political history of American science at the U.S. Studies Program of the University of the Americas in Puebla, Mexico, in March. In April he spoke on "Biologists and Social Responsibility" at the Science Museum in London. . . . **Yaakov Garb** and **Minashi Menon**, STS graduate students, are the first two students to be awarded MacArthur Fellowships for the Humanistic Study of Environmental Issues. . . . **David Mindell**, 'G, has been awarded a National Science Foundation Fellowship for graduate study in the history of science and technology.—Phyllis Klein, STS Program, MIT, Room E51-128, Cambridge, MA 02139.

## Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

**William N. Flanders**, '13; February 25, 1975, Wellesley Hills, Mass.  
**Leslie B. White**, '17; March 5, 1992; South Easton, Mass.  
**Martha Taylor**, '19; March 3, 1992; Cambridge, Mass.  
**Edward P. Clark**, '21; March 7, 1992; Damariscotta, Me.  
**Frank E. Huggins, Jr.**, '21; January 5, 1979; Fort Myers, Fla.  
**E. Irving Bell II**, '22; 1991; Portland, Conn.  
**Irving J. Kahan**, '23; July 3, 1991; Hallandale, Fla.

**Russell E. Randall**, '23; March 14, 1992; Pasadena, Calif.  
**Stearns H. Whitney, Sr.**, '23; April 10, 1992; Concord, N.H.  
**Harry G. Burks, Jr.**, '24; April 8, 1992; Hightstown, N.J.  
**Stanley T. Cook**, '24; December 31, 1990; Grand Rapids, Mich.  
**Samuel J. Helfman**, '24; April 26, 1990; Denham Springs, La.  
**Harry J. Stievater**, '24; July 1, 1991; Buffalo, N.Y.  
**Leroy J. Davis**, '25; November 27, 1991; Tafton, Pa.  
**Louis F. Kreek**, '25; March 24, 1992; Washington, D.C.  
**Alexander J. Rokicki**, '25; March 29, 1992; Delmar, N.Y.  
**Robert W. Conly**, '26; March 18, 1992; Kennett Square, Pa.  
**Albert L. Entwistle**, '26; February 6, 1992; Louisville, Ky.  
**Stanton L. West**, '26; 1991; St Petersburg, Fla.  
**Ernest C. Hinck, Jr.**, '27; February 10, 1992; Irving, Tex.  
**Harold F. Porter**, '28; March 25, 1992; Wilton, Conn.  
**Edwin R. Gardner**, '29; April 15, 1992; Pinellas Park, Fla.  
**Almer F. Moore**, '29; March 10, 1992; Birmingham, Mich.  
**Charles A. Whitney**, '29; November 24, 1991; Santa Monica, Calif.  
**Archie Wolbarsht**, '29; September 29, 1991; Arlington, Va.  
**Mahlon H. Bragdon**, '30; 1991; Natick, Mass.  
**Homer L. Davis, Jr.**, '30; February 28, 1992; Menlo Park, Calif.  
**Myron S. Falk, Jr.**, '30; April 26, 1992; New York, N.Y.  
**Leonard H. Goodhue, Jr.**, '30; April 27, 1992; Winchester, Mass.  
**Robert B. Rypinski**, '30; March 13, 1992; Playa Del Rey, Calif.  
**Arthur C. Rubey, Jr.**, '31; November 8, 1971; Kerrville, Tex.  
**Herman C. Phillips**, '32; 1991; Stone Harbor, N.J.  
**Cole A. Allen**, '33; April 15, 1992; Honeoye Falls, N.Y.  
**William H. Humphreys**, '33; 1991; Houston, Tex.  
**James P. Warbasse, Jr.**, '33; March 29, 1992; New Bedford, Mass.  
**Lyman H. Allen, Jr.**, '34; April 18, 1992  
**David Ballantine**, '34; November, 1989; Barrytown, N.Y.  
**Charles G. Glueck**, '34; March 27, 1992; Newcastle, Me.  
**Harold C. Leighton**, '34; April 6, 1992; Fairhope, Ala.  
**William J. Bates**, '35; March 28, 1992; Venice, Calif.  
**Frederick C. Draemel**, '35; August 14, 1991; Concord, Calif.  
**Joseph L. Fisher**, '35; February 19, 1992; Arlington, Va.  
**Charles S. Kuebler**, '35; 1988; Summit Hill, Pa.  
**Lee A. Reid**, '35; June 20, 1991; Pasadena, Calif.  
**Aurelius P. Hornor, Jr.**, '36; March 9, 1992; Powhatan, Va.  
**Wilbur F. Jordan**, '36; February 29, 1992; Hobe Sound, Fla.  
**Arthur S. Nyquist**, '36; February 24, 1992; Darien, Conn.  
**Edward A. Brittenham, Jr.**, '37; December 21, 1991; Bedford, N.H.  
**Frank D. Lewis**, '37; April 10, 1992; Lexington, Mass.  
**Leo P. Tarasov**, '37; 1991; Framingham, Mass.  
**Edward A. Coomes**, '38; March 7, 1992; South Bend, Ind.  
**D. Sinclair Scott**, '38; June 24, 1991; Buffalo, N.Y.  
**Cornelius J. Starr**, '38; March 18, 1992; Houston, Tex.  
**H. Kendall Raymond**, '39; October 2, 1991; San Francisco, Calif.  
**Leo W. Welch**, '39; June 28, 1990; Cagayan de Oro City, Philippines  
**Augustin Cabrer**, '40; March 23, 1992; Humacao, P.R.  
**A. Gregory Jameson**, '40; March 26, 1992; New

York, N.Y.  
**Robert E. Bailey**, '41; April 15, 1992; Silver Spring, Md.  
**James S. Cooney**, '41; April 1, 1992; Attleboro, Mass.  
**Eugene E.D. Crawford**, '41; January 17, 1992; Kentfield, Calif.  
**Edgar W. Engle, Jr.**, '41; February 19, 1990; Rogers, Ark.  
**William L. Fader, Jr.**, '41; December 10, 1991; Pittsburgh, Pa.  
**Walter J. Kreske**, '41; January 2, 1992; Newton Centre, Mass.  
**Alexander F. Leonhardt**, '41; March 10, 1992; Darien, Conn.  
**Richard X. Gannon**, '42; April 3, 1992; Westboro, Mass.  
**Warren Fuchs**, '43; 1991; Syosset, N.Y.  
**Morton L. Schultz**, '43; 1991; Rockville Centre, N.Y.  
**Guy M. Pound**, '44; 1991; Crescent City, Calif.  
**William R. Niedhamer**, '45; March 8, 1991; Orville, Calif.  
**James W. Hawthorne**, '46; September 20, 1991; Stamford, Conn.  
**Benjamin L. Averbach**, '47; April 1, 1992; Belmont, Mass.  
**T. Robert Kealey**, '47; August 3, 1991; Lemoyne, Pa.  
**Robert R. Moats**, '47; 1991; Mount Prospect, Ill.  
**Winfred E. Berg**, '48; July 8, 1991; Alexandria, Va.  
**Sanford M. Siegel**, '48; November 13, 1990; Honolulu, Hawaii  
**Earle P. Blanchard**, '49; April 10, 1992; Cocoa Beach, Fla.  
**Lee E. Davies**, '49; 1991; Menlo Park, Calif.  
**Henry A. Dick**, '49; 1991; Atlanta, Ga.  
**Thomas Moranian**, '49; March 20, 1992; Winchester, Mass.  
**Alan T. Davenport**, '50; November 9, 1991; Hampstead, N.C.  
**Anthony S. Fiksdahl**, '50; July 31, 1990; Haslum, Norway  
**Pasquale Fischetti**, '50; 1990; Oakland, Md.  
**David T. Keating**, '50; July 19, 1992; Coronado, Calif.  
**Duncan W. MacLeod**, '50; January 19, 1992; Kennebunk, Me.  
**Edward B. Stringham III**, '51; April 4, 1992; New Castle, N.H.  
**Merrill J. Baumann**, '52; March 11, 1992; Naples, Fla.  
**Arthur F. Howard**, '52; March 17, 1992; Sudbury, Mass.  
**Payson B. Palmer**, '52; April 2, 1992; Peoria, Ill.  
**Thomas H. Leith**, '53; July, 1990; Toronto, Ontario, Canada  
**Bernard Zavos**, '53; December 8, 1990; Rockville, Md.  
**Howard W. Babcock**, '54; February 26, 1992; Vienna, Va.  
**Richard C. Varney**, '55; March 23, 1992; Mendon, Mass.  
**Kenneth W. Peterson**, '57; April 4, 1992; Chelmsford, Mass.  
**Armand P. Bond**, '58; 1986; Livonia, Mich.  
**Thomas L. Popper**, '62; February 15, 1992; Caldwell, N.J.  
**Robert E. Baker**, '63; February 5, 1992; Payette, Idaho.  
**Richard W. Freund**, '63; 1991; New York, N.Y.  
**Phillip L. Farnsworth**, '65; 1991; St. George, Utah.  
**John B. Hibbard**, '66; 1991; Elizabethtown, Pa.  
**James D. Campbell**, '68; 1991; Bedford, Mass.  
**William R. Dial**, '68; September 5, 1991; Akron, Ohio.  
**Sandra G. Wiener**, '72; September 24, 1991; Bethesda, Md.  
**Paul A. Balian**, '73; April 5, 1990; N. Palm Beach, Fla.  
**John W. Ernest**, '78; April 26, 1992; Cambridge, Mass.  
**James L. Paddock**, '79; April 6, 1992; Lincoln, Mass.  
**Paul J. Roebber**, '83; 1991; Montreal, Quebec, Canada  
**Frans J.L. De Hertogh**, '84; March 21, 1992; Meise-Wolvertem, Belgium



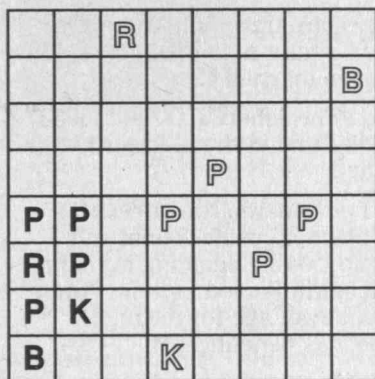
# Out on a Limerick

I must be very brief this issue as I am about to leave for Australia and New Zealand. After the "short" flight from New York to Los Angeles, I change planes for the hop to Sydney, which is your basic 14-hour nonstop endurance test. Wish me luck.

## Problems

**A/S 1.** Unfortunately, **APR 1** was misprinted so that white and black pieces were indistinguishable. As a result we are offering it again (now as **A/S 1**) but with the colors indicated as intended. We apologize for the error.

White is to move and mate in 12.



**A/S 2.** A real cute one from Jan Davis who writes:

The wife of a man who grew barley  
Was also the sister of Charlie.

Her Neighbour grew hay  
And was married to Ray,  
And one of these girls was named Carly.

The girl who was married to Wayne  
Lived next to the farm that grew grain.  
She liked to eat celery  
That was grown by Valerie,  
And she weighed 80 pounds more than Jane.

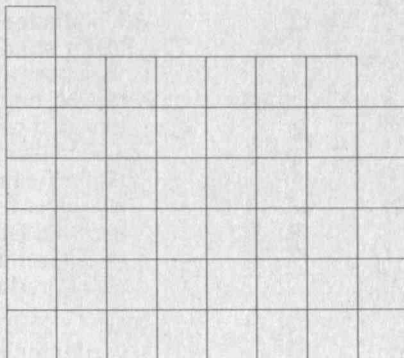
The woman whose husband grew dill  
Was never married to Bill  
When Jane married Benny  
And Ray married Jenny,  
She went out drinking with Jill.

NOTE: ONLY ONE COUPLE HAS RHYMING NAMES.



SEND PROBLEMS, SOLUTIONS,  
AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

**A/S 3.** Our last regular problem is "Golomb's Gambits" edited by Solomon Golomb in the *Johns Hopkins* magazine. You are to dissect the figure below into four congruent pieces.



## Speed Department

Tom Lydon asks: Two days ago I was 38. Next year I start my 42nd year. How old am I, what is my birthday, and what is today's date?

## Solutions

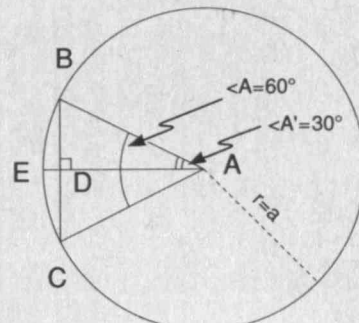
**APR 1.** As indicated this problem was misprinted in April and the corrected version appears above.

**APR 2.** Arthur Wasserman sent us the following solution. The general problem of minimizing the number of training sessions required when there are  $n$  robots serving  $n+k$  users is solved as easily as the  $n=7, k=3$  case. Clearly no robot can be trained to less than  $k+1$  users; if a robot has only  $k$  potential users and precisely those users do not require the services of a robot then the remaining  $n$  users cannot be satisfied. Thus the minimum is at least  $n(k+1)$ . This number is easily seen to be adequate. Number the users from 1 to  $n+k$  and train robot  $j$  to user  $j$  and also to the  $k$  users  $n+1$  to  $n+k$ . If any of the first  $n$  users require the services of a robot, they use the correspondingly numbered robot; if they do not require the use of a robot their robot is freed up to serve one of the  $k$  users  $n+1$  to  $n+k$ .

Robert High notes that we are assuming that when it is time to assign robots to workers, we know in advance all the workers to whom robots are to be assigned.

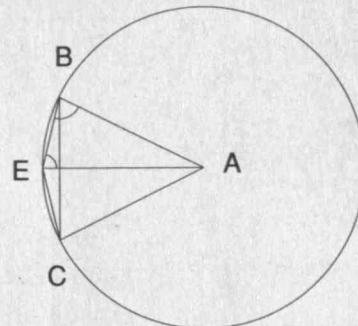
**APR 3.** Our final solution is from Joel Brainard:

First, draw an equilateral triangle in a circle of radius " $a$ " and bisect the triangle with another radius as shown below. (While it is not necessary to use the circle, it is a convenient device that helps show what is going on.)



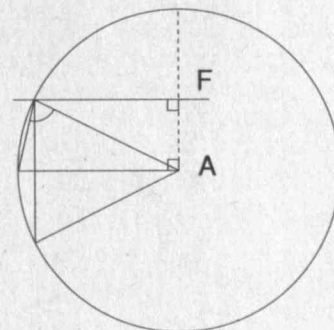
By construction we know that the length of line segment BD is  $a/2$  and that angle A is 60 degrees. Hence angle  $a'$  is 30 degrees.

Second, draw chords BE and EC.



By construction, triangle ABE is isosceles with the length of sides AE and AB equal to  $a$ . This means that angles B and E must equal one another and be 75 degrees each.

By drawing parallel (and perpendicular) lines as shown below we can see that we have constructed the figure presented in APR 3 where AF is  $a/2$  in length and the angle in question is 75 degrees.



## Other Responders

Responses have also been received from M. Fountain, K. Rosato, S. Theriault, L. Steffens, R. Whitman, A. Cangahuala, W. Hartford, R. Arrison Jr., E. Sard, G. Stallings, E. Signorelli, H. Hodara, P. Card, S. Root, N. Wickstrand, B. Gunther.

## Proposer's Solution to Speed Problem

39, 31 December, 1 January.



# MIT LIFE INCOME FUNDS

## ALBERT J. O'NEILL

HOME: Milton, Massachusetts

**CAREER:** The son of a contractor and builder, Mr. O'Neill decided during high school to go into the construction industry. MIT was offering a new course in building engineering and construction, and Mr. O'Neill knew a family that sent four sons there, so the decision to attend MIT was easy. Earning his S.B. in 1932, he worked in government geological surveys for three years, before becoming a construction engineer for private contractors. He spent the war years as a superintendent of construction, specializing in marine installations, for the U.S. Navy, and then joined MIT's building engineering department, which was later absorbed into civil engineering. He taught, conducted research and published in the field of materials—primarily wood, metals and masonry. He later became involved with MIT's Technology and Development Program, a project funded by the U.S. Agency for International Development to help developing countries strengthen their engineering capabilities. He retired in 1988.

Mr. O'Neill's hobbies are travel, photography, gardening and local senior activities. He and his wife Helen have been married 42 years.

**GIFT OF CAPITAL:** The Albert J. O'Neill (1932) and Helen J. O'Neill Fund in the Maclaurin Pooled Income Fund.

**QUOTE:** When I considered the effect MIT has had on my life, both professional and personal, I had no trouble deciding to make a gift to the Maclaurin Pooled Income Fund. It has been a tax advantage for me and, at the same time, has benefitted MIT.

**For more information** about gifts of capital, write or call Frank H. McGrory or W. Kevin Larkin at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo:  
Richard Howard



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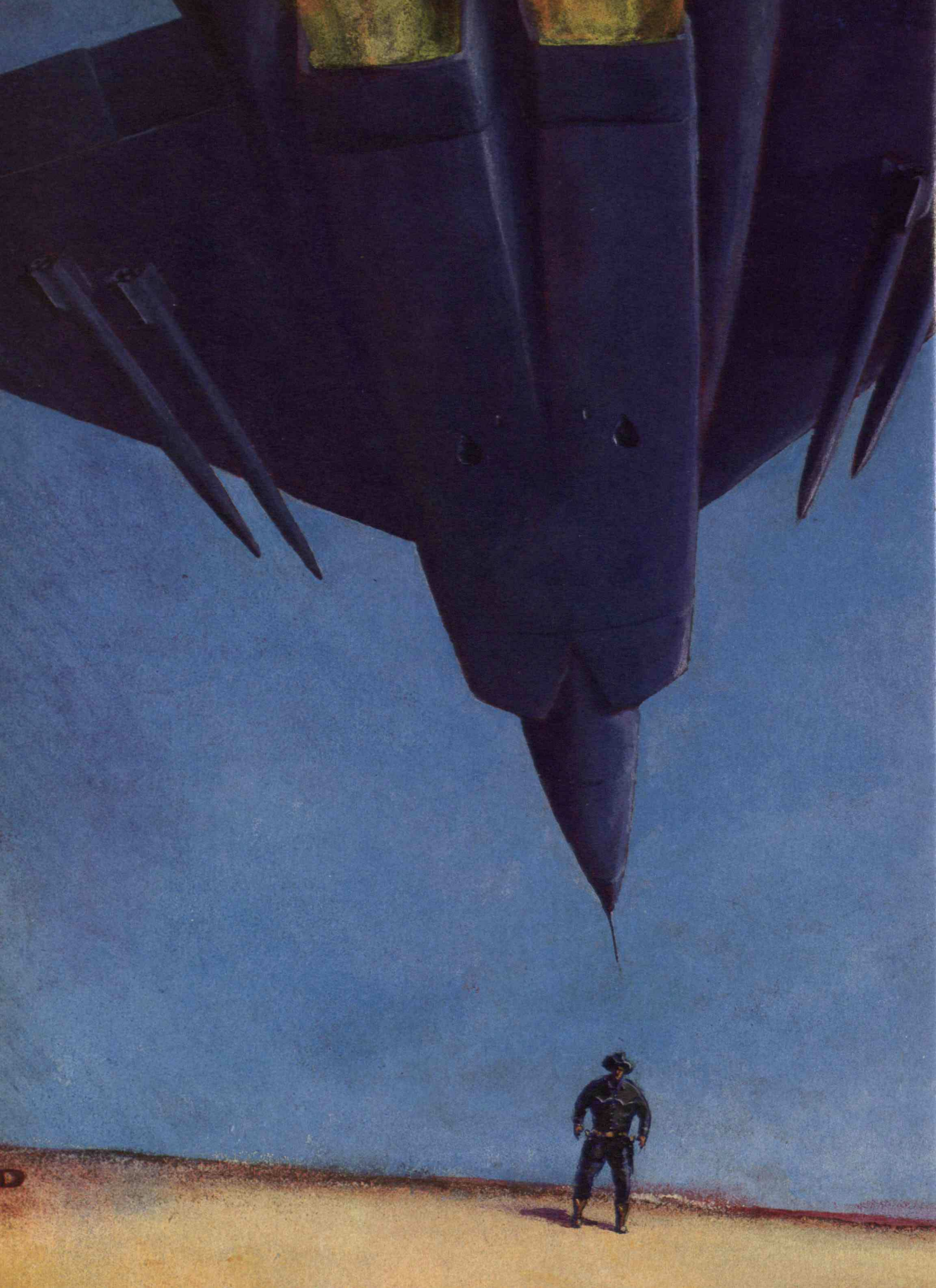
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# THE F-22

## An Exercise in Overkill

BY DAVID CALLAHAN

*The end of the Cold War has transformed the planned Air Force superfighter into a musclebound extravagance.*

FOR many U.S. companies in the arms business, it was a dark day when the Pentagon released its new budget request early this year. Billions of dollars worth of major weapons programs were canceled, and from the grumbling on Capitol Hill, it seemed clear that further cuts were in the works. But for one defense contractor, Lockheed Aeronautical Systems, the news from the Pentagon could hardly have been better: the new Air Force Advanced Tactical Fighter, Lockheed's F-22, emerged from the latest round of belt-tightening unscathed. Despite the end of the Cold War, plans to buy 648 of these ultra-high-tech aircraft are still on track.



WITH

THE FORMER  
SOVIET UNION  
BEGGING THE WEST  
FOR AID, THE  
CASE FOR A  
QUANTUM LEAP IN  
FIGHTER TECHNOLOGY  
IS HARDLY  
COMPELLING.

The F-22 was unveiled in April 1991, amid much fanfare, when the Lockheed aircraft beat out Northrop's F-23 after a fierce five-year design competition. In announcing their choice, Air Force officials hailed the plane as a technological marvel. By all accounts, this is no exaggeration.

The F-22 combines every fighter pilot's fantasies into one plane. It can cruise at well above the speed of sound without using inefficient afterburners. Its maneuverability, key for winning aerial dogfights, is said to be phenomenal. It can fly farther and is easier to maintain than the current state-of-the-art warplane, the F-15. On top of all this, the F-22 is reputedly as invisible to radar as the F-117, the stealth fighter-bomber that performed so spectacularly in the Persian Gulf.

With all its futuristic technology, the F-22 may end up costing well over \$100 million per aircraft. The total price tag—at least \$98 billion through the year 2012—makes the plane one of the most expensive weapons programs in Pentagon history.

The question is, who, in the new era, will this super-fighter be used against? Air Force Secretary Donald Rice has asserted that “the F-22 is not designed for the threat of today, or even tomorrow, but to meet and defeat the threats of the twenty-first century.” Yet what exactly *are* the threats of the twenty-first century? The Air Force has failed to answer this question persuasively.

When it was begun in the early 1980s, the Advanced Tactical Fighter (ATF) program was geared toward a single purpose: to counter the new fighters that the Soviet Union was expected to field in the mid-1990s. Now it seems clear that those enemy warplanes will never take to the skies. “Today we have no global challenger,” said Defense Secretary Dick Cheney in January. “The threats have become remote, so remote that they are difficult to discern.” With the states of the former Soviet Union begging the West for aid, and with no major rival to U.S. power on the horizon, the case for taking a quantum leap in fighter aircraft technology is hardly compelling. Still, despite its whopping cost and now dated mission, the F-22 has encountered remarkably little flak in Congress. As things now stand, the plane will almost certainly be built.

How can a budget-breaking weapons program, justified for years strictly on Cold War grounds, slip under the radar of Capitol Hill's budget cutters and Pentagon watchdogs?

The survival of the F-22 can be explained largely by looking at the new politics of defense. That politics has been shaped in great part by two ideas put forth by Pentagon planners: first, that the United States must maintain overwhelming technological superiority in the new era as a hedge against “uncertainty”—the revival of Russian power or the emergence of a new superpower; and second, that high-technology weapons like the F-22 will be needed to fight well-equipped Third World adversaries in the not-so-dis-

tant future. This grim geopolitical logic has found a receptive audience in Washington, where Pentagon warnings of a “still dangerous world,” combined with the familiar dynamics of congressional pork barreling, have salvaged numerous arms programs whose rationales disappeared along with the Soviet Union.

### Countering the Soviet Threat

During four decades of Cold War, the United States sought to exploit its technological edge to offset the Soviet Union's numerical advantage in weapons. The deployment of the F-15 air superiority fighter in the early 1970s exemplified this effort. The F-15 was—and still is—the most sophisticated fighter plane ever built. Its design incorporated all the advantages of a heavy multipurpose fighter—long combat range, large armaments load, all-weather capability, and state-of-the-art electronics—without sacrificing aerial maneuverability. In the event of a war with the Soviet Union, the F-15's mission was to outfight swarms of less sophisticated Soviet aircraft.

Even as the F-15 assumed its place in the pantheon of fighter aircraft, Pentagon planners worried about its eventual obsolescence. The Soviet pace of fighter modernization “far surpasses that of the U.S.,” said Assistant Secretary of the Air Force Alton Keel, Jr., in spring 1982. Air Force officials warned that the Soviets were beginning to field aircraft comparable to the F-15 and F-16 as part of an aggressive effort to achieve military superiority over the West. Future generations of Soviet

---

DAVID CALLAHAN is author of *Dangerous Capabilities: Paul Nitze and the Cold War* (HarperCollins, 1990). He is writing a book on the future of U.S. national security policy.





**THE F-22'S**  
**SPEED AND**  
**MANEUVERABILITY—**  
**EMBODIED HERE IN A**  
**PROTOTYPE—COME**  
**AT A HIGH PRICE:**  
**POSSIBLY OVER**  
**\$100 MILLION**  
**PER PLANE.**

fighters expected for the 1990s would be even more capable. The Soviets were not only keeping their numerical edge, Keel said, but were now “narrowing the technology gap.”

The ATF was the Air Force solution to these ominous trends. And from the beginning, the service had big plans for its new fighter. The Air Force imagined a design that combined an array of new technologies into a single awesome aircraft. The plane would be a full generation more advanced than existing fighters, just as the F-15 had been when it was introduced in the 1970s.

For all that the ATF offered—speed, stealth, maneuverability—the Air Force promised a remarkably modest price tag. The final cost, officials predicted in 1986, would be roughly comparable to that of the F-15: \$35 million a plane in 1984 dollars. A long history of Pentagon cost overruns should have made Congress suspicious of this estimate. Yet few questions were raised about the plane’s cost through the free-spending 1980s.

As funding requests for the ATF increased over the course of the decade, Pentagon assessments of future Soviet aircraft became ever bleaker. The next generation of Soviet fighters, due out by the mid-1990s, “will have maneuvering capability and fire control systems vastly superior to our most advanced F-15s and F-16s,” pre-

dicted a top Air Force official in 1985. Just as ominously, the Air Force warned that the Soviets were perfecting “lookdown, shootdown” radar and beefing up their battle management capabilities, better enabling them to simultaneously track and attack numerous low-flying aircraft.

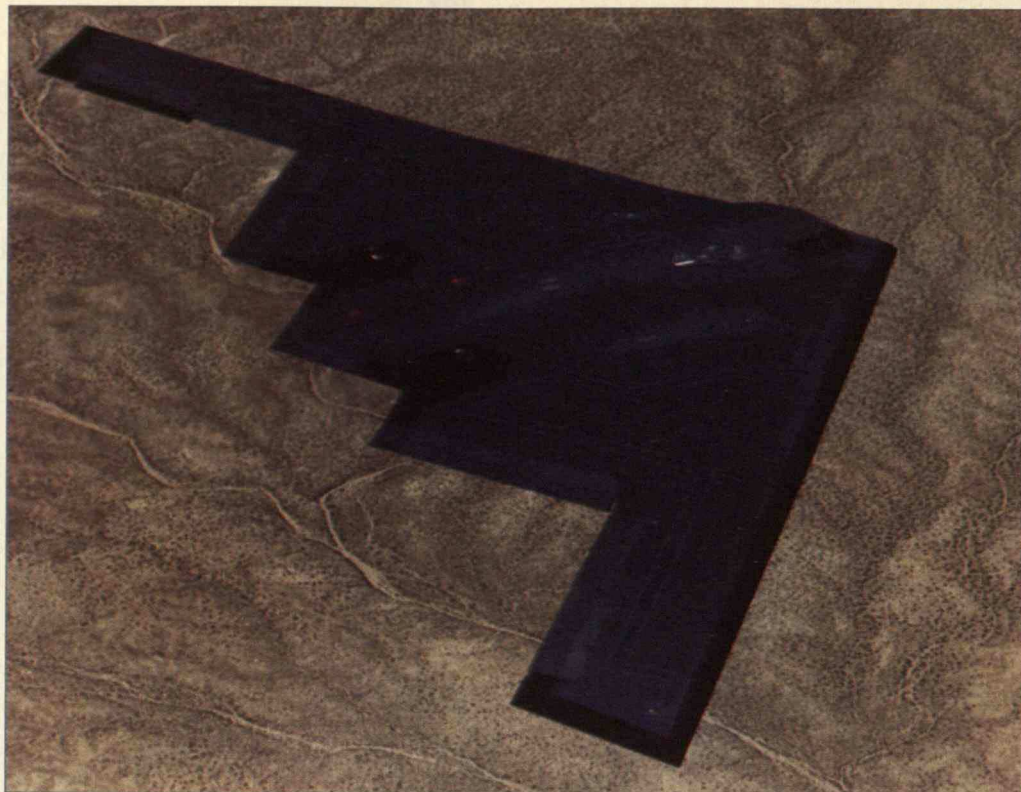
Even in the mid-1980s, when Mikhail Gorbachev took power and began his reform program, the forward march of Soviet technology seemed to those in the nation’s capital as dependable a feature of life as the spring brilliance of Washington’s cherry blossoms. And because the development of the ATF was predicated on this forward march, it was as much a Cold War weapons system as the B-2 stealth bomber or the MX missile. “The program schedule is driven by the threat,” stated a 1987 Air Force document. Never once, through the 1980s, did the Air Force point to adversaries besides the Soviet Union to justify its development of a new fighter.

### The Case Unravels

With its economy in shambles and its political system imploding, the Soviet Union was, by early 1990, no longer a viable contestant in the conventional military competition with the Western world. Nor, many sus-



CONGRESS HAS  
 PEGGED THE B-2  
 STEALTH BOMBER AS  
 A COLD WAR RELIC,  
 LARGELY BECAUSE  
 IT IS DESIGNED  
 FOR NUCLEAR  
 CONFRONTATION.  
 BUT THE F-22, WITH  
 ITS LESS NARROW  
 MISSION, HAS  
 ESCAPED SIMILAR  
 SCRUTINY.



pected, could it be such a contestant again in the foreseeable future. In historic testimony before Congress in March 1990, CIA Director William Webster announced that the Soviet threat had permanently diminished. No Soviet government of the near future would be likely "to seek a broad reversal of the changes that have occurred in Eastern Europe, or try to revive the Warsaw Pact."

What's more, it seems clear in retrospect that there was a significant incongruity between Pentagon assessments of the Soviet Union's future high-tech military prowess and mounting evidence of its economic backwardness. In his 1989 book *Bound to Lead*, Harvard political scientist Joseph S. Nye suggested that "Soviet central planners lack the flexibility to keep up with the quickened pace of technological change in today's information-based economy. They have not come to terms with the third industrial revolution." The worsening Soviet lag in science and technology was not as pronounced in some military areas, Nye wrote, but "in an age of 'smart weapons' that incorporate microchips and sensors, military technology increasingly depends on an advanced civilian electronics sector." Don Oberdorfer of the *Washington Post* observed in his book on the end of the Cold War, *The Turn*, that in 1987 the Soviet Union was estimated to have only 200,000 microcomputers, many of them unsophisticated; the United States had over 25 million.

In 1990, even as Congress appropriated another billion dollars for the ATF, some of its members were beginning to question the need for a new fighter. Although the Senate Armed Services Committee approved the Air Force's FY 1991 budget, it demanded that the the Air Force examine alternatives to the ATF.

The Air Force complied, running 1,200 hours of computer-simulated battles pitting the ATF and an advanced version of the F-15 against hypothetical turn-of-the-century Soviet fighters. The findings, presented to Congress in early 1991, were predictable. "The study results show that the ATF is far more capable of achieving air superiority against the evolving threat," reported Maj. Gen. Joseph Ralston, a top Air Force acquisition official. In arguing for a continuance of the ATF program, Ralston also fell back on the Air Force argument used to justify the B-1 bomber boondoggle: since \$5 billion had already been spent on the ATF in the 1980s, Ralston said, it was wisest to press on rather than opt "for what is essentially a paper design of alternatives." Although the Advanced Tactical Fighter remained years away from full-scale production, the Air Force argued that it was too late to stop the program.

Alarm bells were now sounding at the Congressional Budget Office. A CBO study conducted in 1991—by which time the plane's price tag had doubled—raised serious doubts about the program's cost and necessity. "If history is a guide, the ATF could cost \$100 million





**THE F-15 IS THE MOST ADVANCED FIGHTER PLANE IN THE WORLD. ACCORDING TO A CONGRESSIONAL BUDGET OFFICE ASSESSMENT, UPGRADED VERSIONS COULD BEST ANY FORESEEABLE THREAT.**

apiece or even \$135 million,” warned CBO analyst Robert Hale in April testimony before the Senate Armed Services Committee. (By “history” he meant the cost increases that occurred in the F-15 and F-4 programs.) At such a high unit price, said Hale, the Air Force would have no hope of sustaining its planned post-Cold War force of 26 tactical fighter wings (roughly 2,600 aircraft). In the absence of sharply increased funding from Congress—highly unlikely in the 1990s—the Air Force would find itself with only 12 to 16 tactical fighter wings if it went forward with the ATF.

The CBO report also questioned the need for developing a new fighter plane now that the Cold War was ending. The Soviet Union’s turn inward, said Hale, “would drastically reduce the threats posed to U.S. tactical air forces because the capabilities of potential adversaries other than the Soviet Union are much more modest.” In light of a declining Soviet threat, the CBO believed that the United States could probably meet its security needs by canceling the ATF and upgrading existing fighter aircraft.

In December 1991 the already weak case for the ATF—now officially the F-22 after Lockheed’s victory over Northrop—became even weaker with the final collapse of the Soviet Union. The director of the Defense Intelligence Agency, Lt. Gen. James R. Clapper, informed the Senate Armed Services Committee in Jan-

uary 1992 that the once vaunted Soviet military machine was rapidly falling apart. Russia was cutting procurement of new weapons “by about 80 percent,” he said, and military R&D “may be reduced by as much as 30 percent from last year.”

Could the threat from the East return some day soon in the form of a new and revived Russian militarism? This is doubtful even according to Defense Secretary Dick Cheney, long known as the cabinet member most wary about the Soviet peril. Cheney told the Senate Armed Services Committee on January 31 that the Soviet GNP had plummeted by 15 to 20 percent in 1991 alone. “It is improbable that a global conventional challenge to U.S. and Western security will reemerge from the Eurasian heartland for years to come,” he said.

### **A New Rationale**

Changing circumstances haven’t deterred the F-22’s proponents. After the fall of the Berlin Wall in November 1989, the Pentagon began to concoct a new rationale for American military power. Pentagon officials insisted that a continued large U.S. military establishment would be needed to counter Third World challengers, as well as to promote worldwide stability and to cope with any new global military threat that might arise.

The Air Force took a lead role in refining this strategic



IN THE 1980S, THE  
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SOVIET FIGHTERS LIKE THE  
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FOLLOW-ONS THAT NOW  
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MATERIALIZE.



concept. "The world of the 1990s and beyond is likely to be characterized by a combination of political instability, serious economic dislocation, and widespread military power," the Air Force argued in a 1990 policy manifesto entitled *Global Reach, Global Power*. "The likelihood that U.S. military forces will be called upon to defend U.S. interests in a lethal environment is high, but the time and place are difficult to predict."

Without breaking stride, the Air Force began justifying the ATF within this new strategic paradigm. "I believe that our research and development investment strategy must be looked at quite independently of a specific threat by a specific adversary," said Air Force official John J. Welch in March 1990. "We must maintain technological superiority in an environment that is changing." Just because specific threats were currently unclear, Welch added, did not mean that the U.S. should cancel weapons systems that "our grandchildren will probably operate." The Air Force insisted that the technology represented by the ATF program was a necessary hedge against uncertainty.

As the Pentagon itself has acknowledged, however, a prudent military R&D effort does not require full-scale production of cutting-edge weapons systems. In January, Secretary Cheney told Congress that the United States would hold off on making many new armaments once test models had been designed and developed. This "prototyping" approach reflects the belief, held by all senior administration officials, that the United States would have years of warning before a new global threat could arise.

The F-22 is precisely the kind of weapons system that can now be moved to the backburner, as has been sug-

gested by mainstream defense analysts such as Gordon Adams, head of the Defense Budget Project in Washington, D.C. If a new global threat emerges, the existing F-22 design would allow the United States to begin full-scale production without facing a dangerous delay.

But to the Air Force, things are not so simple. Beyond citing the uncertainty of world politics and the possible emergence of a new superpower, the Air Force argues that the F-22 is needed to handle future Third World adversaries. "As weapons production becomes global, increasingly lethal weapons are available to smaller powers and regional states," warned a top Air Force general, Richard Hawley, four months before the Persian Gulf crisis began. "Third World battlefields will be in many ways as demanding as those we could expect in central Europe."

The fear is not that developing nations might produce jets to rival America's finest. Rather, Pentagon planners evidently worry that allies like France, Britain, or Germany will. In May 1991, for example, Air Force Secretary Rice warned that two Western fighters under development—the European Fighter Aircraft and the French Rafale—will be more advanced than the F-15 and F-16. Although the United States is unlikely to find itself at war with its European friends, these new planes could conceivably be sold to Third World nations, much as advanced French Mirage fighters were sold to Iraq. The F-22 would safeguard U.S. air superiority in the face of such developments, allowing U.S. forces to prevail "anywhere any time against any threat," Rice told Congress in February 1992.

Pentagon leaders cite the Persian Gulf War to buttress their case for continuing to push the frontiers of military



## DESERT STORM

SHOWED THAT EVEN  
THE BEST-EQUIPPED  
THIRD WORLD  
CHALLENGERS  
LACK THE  
TECHNOLOGICAL  
SOPHISTICATION  
AND TRAINING  
TO TAKE ON A  
WESTERN  
POWER.

technology. "Future adversaries may have ready access to advanced technologies and systems from the world arms market," warned Cheney in January. "The war showed that we must work to maintain the tremendous advantages that accrue from being a generation ahead in weapons technology."

But are future Third World threats—particularly in the realm of air power—as serious as the Pentagon claims?

Simple arithmetic suggests that they are not. The long-standing rationale for U.S. efforts to field revolutionary jet fighters, including the ATF, was to overcome a numerical inferiority relative to the Soviet Union. Now, in making its post-Cold War pitch for the F-22, the Air Force has sought to keep this argument alive. In a September 1991 report, the service argued that offsetting large numbers of enemy aircraft with "smaller numbers of even more sophisticated and stealthy F-22s is not merely desirable, but mandatory, if America is to retain its air superiority edge in the potential combat environments of the future."

The trouble is, an air force to match that of the United States in numbers is nowhere in sight. According to the 1991 CBO study, the United States will maintain a considerable numerical lead over likely Third World adversaries such as North Korea or Cuba. "Even after the planned reduction in U.S. forces to 26 wings, the U.S. advantage would range from a low of 4 to 1 to a high of 16 to 1," CBO analyst Hale told Congress. And the U.S. edge over potential Third World adversaries would always be tremendous given American advantages in intelligence, training, and battle management—all so vividly displayed during the Gulf War. U.S. sophistication in spaced-based reconnaissance and communications satellites, for example, is clearly unmatched by any Third World power.

Indeed, the real lesson of the Gulf War may be very different from what the Pentagon would have Congress and the public believe. Iraq, it was commonly said, had one of the finest integrated air defenses in the Third World. It also had a highly advanced air force, which boasted some of the best French- and Soviet-made fighters available. Yet this equipment proved nearly worthless in Iraqi hands. When war came, Iraq's air defenses crumbled, and its air force barely fought; U.S. losses were negligible. Far from substantiating the Pentagon's

grim assessment of future Third World threats, Desert Storm showed that even the best-equipped Third World military challengers are likely to lack the broader technological sophistication and training required to take on a Western power.

Contending with the future Iraqs of the world—if there are any out there—simply will not require aircraft of the F-22's caliber. The U.S. numerical edge over potential Third World adversaries, combined with myriad technological advantages, will assure air superiority with the current generation of fighters.

The continuation of the F-22 program, which next year alone will cost \$2.2 billion, defies logic. Pentagon claims about the F-22's role in an uncertain environment have clearly swayed a cautious Congress. But as these claims are not altogether persuasive, it is hard to escape the conclusion that other factors may be pushing the F-22 forward.

One such factor is almost certainly the bureaucratic and economic momentum that gathers behind any weapons program of this size. Less tangibly, the element of national pride may be at work. Although futuristic military machines like the F-22 cannot make up for economic losses in key areas of civilian high technology, they provide a comforting reminder of the industrial strength and technological know-how that the United States can still muster. The high-tech wizardry of the Persian Gulf War offered this kind of reassurance on a grand scale.

During a time of mounting American self-doubt, a big attraction of the F-22 to the Bush administration and Congress may be its symbolic value; the aircraft is evidence that America can still win at something, and it signifies U.S. resolve to stay preeminent in at least one category of national power. As global economic competition intensifies, however, Washington's attachment to futuristic military technology grows ever more costly.

Ultimately, the strongest case for the F-22 is that it represents an insurance policy of sorts: America should invest in this fighter on the slim chance that the world security environment could turn very dangerous very quickly. But like any consumer, the U.S. government can never have an infinite amount of insurance. It must shop wisely, seeking the most affordable policy to cover the most likely eventualities.

By these criteria the F-22 is a bad buy. ■





# *EVs: On the Road Again*

*E*lectric vehicles have failed before.

*But they're making a comeback, and this time the prospects are better.*



**I**T was 1976, and air-polluting, gas-guzzling American cars were under fire. Congress was toughening pollution laws. The OPEC-induced oil embargo remained fixed in the public's mind. Newly elected president Jimmy Carter was preaching energy independence. The watchword was alternatives—alternative energy sources, alternative fuels, and alternative vehicles.

Riding this wave, the U.S. Department of Energy announced the Near Term Electric Vehicle (NTEV) program—an ambitious plan to quickly develop a practical electric car. Instead of a gasoline tank, the NTEV's car would carry a pack of rechargeable batteries. Instead of an internal-combustion engine, an electric motor would be used. When driven short daily distances by commuters,



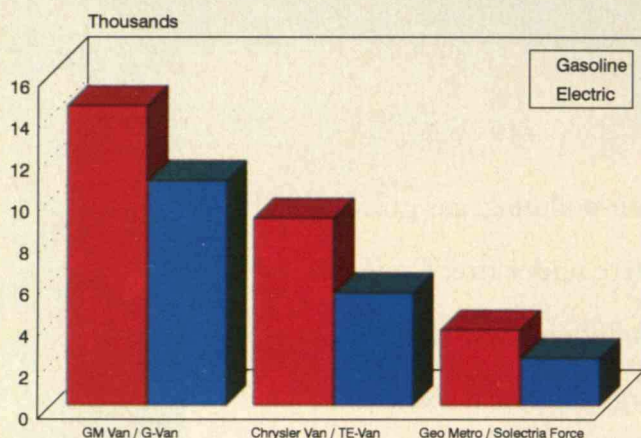
BY GILL ANDREWS PRATT

PHOTOS: PETER A. SIMON/PHOTOTAKE; INSET: GILL ANDREWS PRATT



## URBAN ENERGY CONSUMPTION

(BTUS OF FOSSIL FUEL PER MILE)



**A** 1989 study by the Electric Power Research Institute (EPRI) compared the energy consumption, in urban driving, of gasoline-powered GM and Chrysler minivans with nearly identical models converted to run on electricity. The analysis focused on total

energy expended, from oil well to the road (or from extraction to power plant to the road). The electric versions consumed 60 to 75 percent of the energy used by their counterparts. A more recent analysis of the Geo Metro showed similar results.

an electric car could be recharged overnight, to the delight of power companies with excess off-peak capacity. Fossil fuels had earned a bad reputation in 1976, and electric cars, which did not directly burn fossil fuels, seemed a wonderful alternative. The adoption of electric cars and nuclear power, which was then expected to provide ever-increasing fractions of the nation's electricity, together promised to lessen both air pollution and our dependence on imported oil.

At the time, the target of a practical electric vehicle seemed very close. In fact, after a short, optimistic feasibility study, DOE leaders told NTEV engineers to immediately begin the design and construction of two prototypes. It was fully expected that within five years these prototypes would serve as direct inspiration for the nation's automobile manufacturers.

Alas, it was not to be. Fifteen years later, the objectives of the NTEV program seem quixotic. Without question, important research was accomplished. The two prototypes were completed. But by the time the program

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ended in 1981, it had failed to even approach its goal of developing an economically viable electric vehicle. Many members of the NTEV program were discouraged, and the electric vehicle was relegated to the status of a "far-out idea."

The NTEV program did not fail because of weak technical work, inadequate funding, or bad management. Rather, it was the immature state of several key technologies that led to economic, performance, and reliability handicaps that were simply too great to overcome. Electric motors were inefficient, electronic devices needed to control the motors were unreliable, and batteries couldn't store enough energy to propel the cars very far.

Today, however, renewed interest in electric vehicles is spreading rapidly. Almost every major automaker plans to introduce a model for sale within five years, and many small companies have been started to capitalize on the trend. The federal government is strongly supporting a new research effort—the U.S. Advanced Battery Consortium—in cooperation with the Big Three automakers to improve batteries for electric vehicles. The California legislature, in an effort to combat smog in Los Angeles, has passed a law requiring that by 1998, 2 percent of any company's in-state sales must be "zero-emission vehicles," meaning electric cars; by 2003, at least 10 percent of sales must meet that standard. The first electric car dealership has just opened in Hollywood. And most impressively, the nation's largest automaker, General Motors, has committed a factory to producing what the company claims will be the world's most advanced electric vehicle, the Impact.

Has a new generation of engineers forgotten the real-world lessons of the NTEV program? Not quite. Over the past 15 years much of the technology required to build electric vehicles—in particular, the motors and electronics—has been maturing. Batteries have gotten better too, although in that department engineers aren't out of the woods.

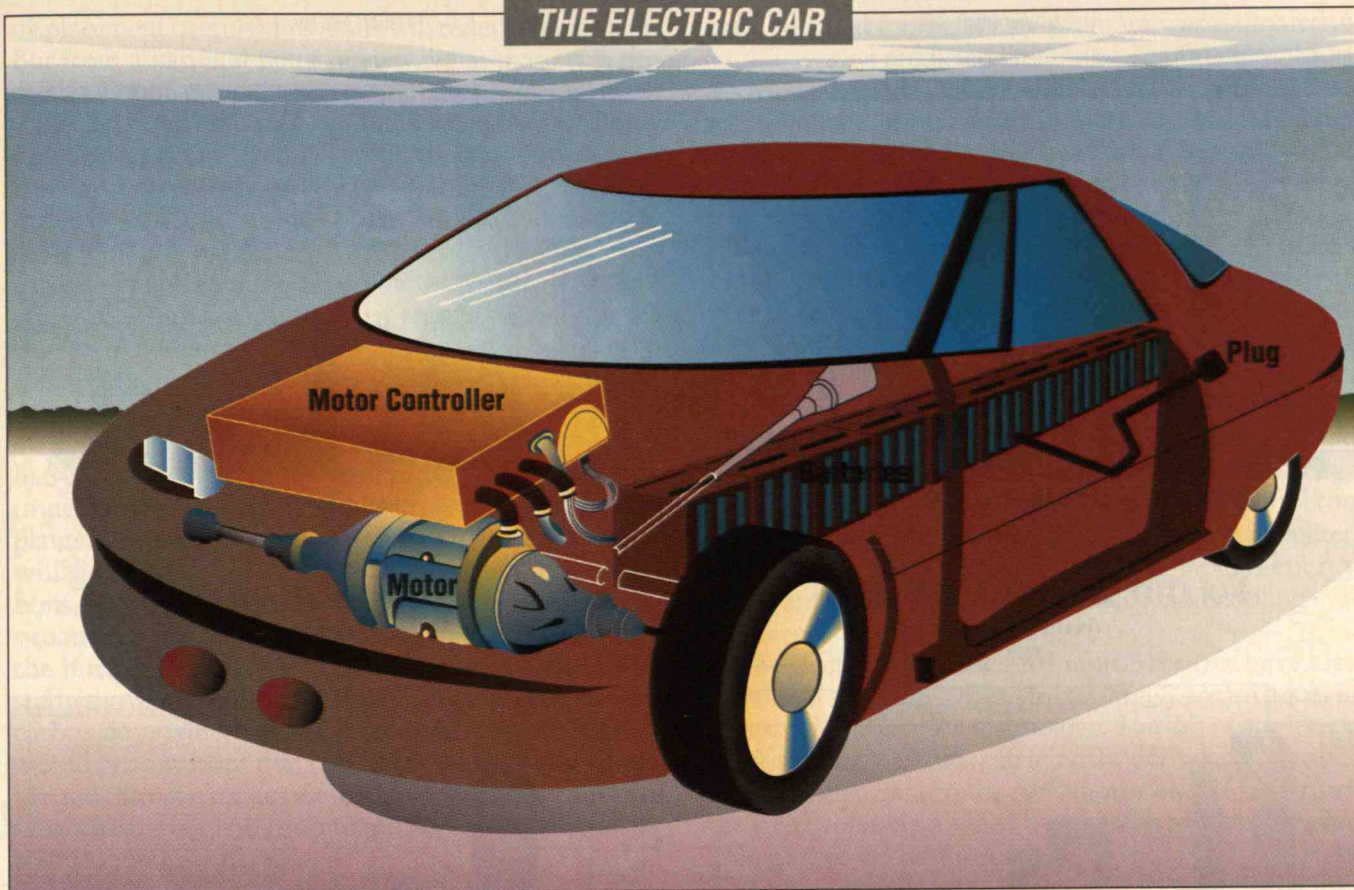
### More Desirable Than Ever

Several forces have triggered the resurgence of electric vehicles. As in 1976, most important are the cars' energy efficiency and ability to reduce pollution.

Today's electric-vehicle motors are about 90 percent efficient, and battery packs are about 80 percent efficient. Upstream of the vehicle, of course, lies a power plant; electricity produced by fossil fuels is delivered to the average urban household at an efficiency of about 32 percent. Multiplying the three numbers yields an urban fuel-to-wheel efficiency of about 23 percent. While this is a bit poorer than the efficiency of a high-mileage gasoline car traveling on the highway, a direct comparison of gasoline and electric vehicles of the same



## THE ELECTRIC CAR



weight and size shows that the latter do save energy in urban driving, their intended use.

In 1989, the Electric Power Research Institute (EPRI) compared nearly-identical minivans converted to run on electricity (see the chart on page 52). This analysis showed that in urban use the electric vans required only 60 to 75 percent of the energy consumed by their gasoline counterparts. This study took into account all energy consumption, for both electric and gasoline vehicles, from the oil well to the road. More recent measurements made by the California Air Resources Board show that the urban energy consumption of the Force, a converted Geo Metro made by Solectria Corp. in Waltham, Mass., is about 63 percent that of a gasoline Metro. And GM's Impact, engineered from the ground up as a flashy, high-performance electric sports car, is much more efficient than any of the others because of its lightweight, highly aerodynamic body and special low-rolling-resistance tires.

If used exclusively for highway travel, electric cars offer no advantage. But because they are intended primarily for urban areas, where frequent stops and starts burn excessive fuel in conventional cars, the energy advantage of electric vehicles in cities is significant.

Another factor favoring electric vehicles is energy flexibility. The U.S. transportation sector depends

*In a typical electric car, a motor provides torque to the front wheels. Batteries to operate the motor are connected in series and are usually placed in a column that runs through the center of the car. An electronic*

*motor controller regulates current through the motor and transforms DC battery voltage to AC motor voltage. The batteries are recharged by connecting an on-board charger to a wall outlet with a cable.*

almost exclusively on crude oil; in 1989, oil accounted for 97 percent of transportation energy consumption. As became clear during the oil shortages of the 1970s, this near-total dependence is a real vulnerability.

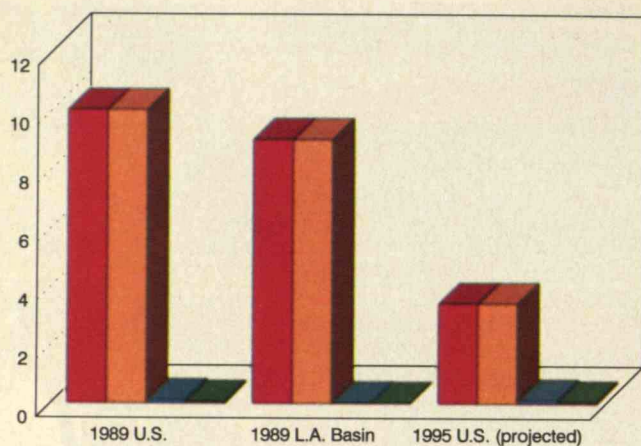
Electricity, by contrast, can be produced from a wide variety of sources. Any move to decouple transportation from oil, even without improvements in overall efficiency, yields great benefits in the ability to switch to other energy sources should crude oil fall into short supply. Electric vehicles help diversify the country's energy mix.

Whether electric vehicles achieve their second major goal—reducing air pollution—depends on what takes place at local power plants. Although electric vehicles generate no air pollution, the same cannot be said of the plants that must generate electricity to recharge the cars' batteries. Because most of the power plants that supply the Los Angeles basin are located outside the region, the



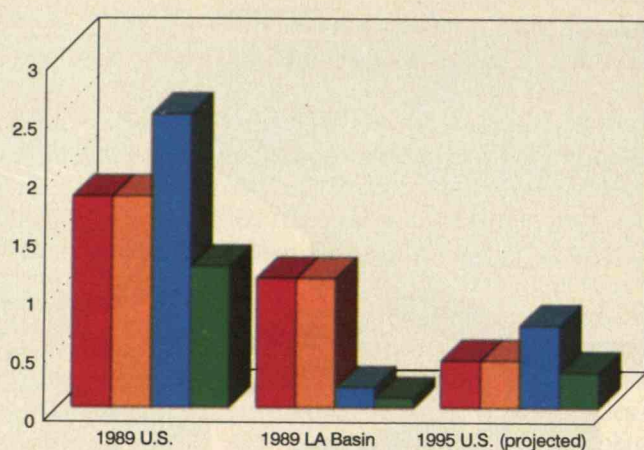
## CARBON MONOXIDE

(GRAMS PER MILE)



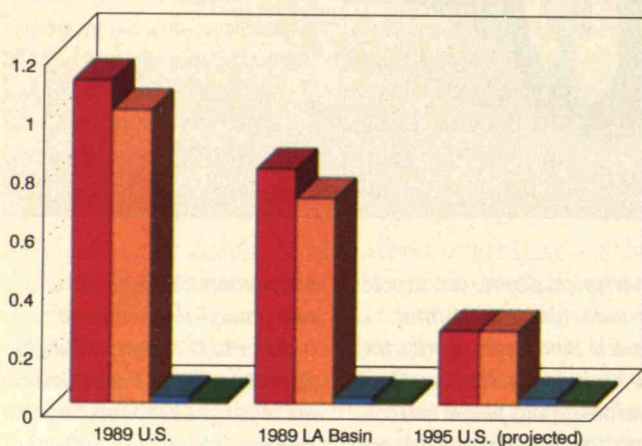
## NITROGEN OXIDES

(GRAMS PER MILE)



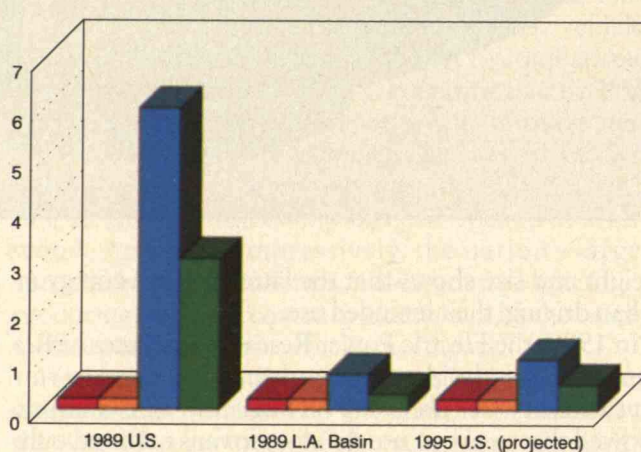
## VOLATILE ORGANIC COMPOUNDS

(GRAMS PER MILE)



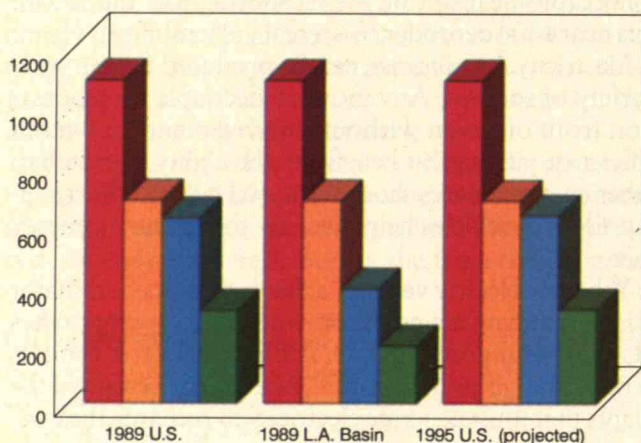
## SULFUR DIOXIDE

(GRAMS PER MILE)



## CARBON DIOXIDE

(GRAMS PER MILE)



**A** 1989 EPRI study compared total emissions, whether by vehicle or power plant, of GM and Chrysler minivans with those of their electric counterparts. The analysis, which was done for both the Los Angeles basin and the nation, included five classes of air pollutants. Electric vehicles accounted for dramatically lower levels of volatile organic compounds, carbon monoxide, and carbon dioxide. But on a national level, they generated more

■ GM Gasoline Van  
■ Chrysler Gasoline Van  
■ GM Electric Van  
■ Chrysler Electric Van

nitrogen oxides and sulfur dioxide. According to estimates by the U.S. Environmental Protection Agency, the latter emissions should drop significantly by 1995 with federally mandated reductions at power plants



displacement of emissions alone will reduce smog there. But from a national point of view, what matters is the total pollution created, regardless of the source.

The type and amount of pollution generated by a utility depends on the sophistication of its pollution controls and on its mix of "dirty" plants, such as those fueled by coal, and "clean" plants, such as hydroelectric generators. As with energy comparisons, to see if electric cars are cleaner than gasoline vehicles of the same size and weight, analysts must take into account all sources of pollution from the oil well to the road.

EPRI performed such a study in 1989 for the Los Angeles area and the entire United States (*see the charts on page 54*). Because a small fraction of the power used in Southern California is generated by burning coal (much of it comes from natural gas and hydroelectric plants), the study showed that the use of electric vehicles will significantly reduce regional levels of hydrocarbons, nitrogen oxides, and carbon monoxide. But the situation is less clear for the rest of the country, where the burning of coal is far more common. The EPRI study showed that levels of volatile organic compounds, carbon monoxide, and carbon dioxide across the nation would be lower but that concentrations of sulfur dioxide and nitrogen oxides would be higher. This translates into a lower contribution to global warming and less smog but more acid rain.

As was true for energy consumption, however, electric vehicles provide more flexibility in improving air quality. Emissions from gasoline engines have steadily declined, but with computerized carburation and advanced pollution controls already in place, further improvements are becoming harder to realize. Utilities, on the other hand, can still make great strides; greater use of environmentally friendly energy sources and better pollution controls can bring down emissions dramatically. Indeed, utilities will be forced in this direction by federal legislation requiring significant reductions in sulfur dioxide and nitrogen oxides in the coming decade.

### Better Technology for Better Cars

Electric vehicles also offer the advantage of being more reliable. Containing three primary components—an electric motor, a motor controller, and a battery pack—the electric vehicle's "power train" is simpler than the engine, transmission, exhaust, and fuel-injection systems of present-day cars. Modern electric motors have only one moving part and no delicate mechanical controls. There are fewer fluid systems, there's no oil to buy or change, and no muffler to replace. Electric cars, then, should require less maintenance and be easier to repair.

The big headache involves the battery pack. In 1980, the large-lot manufacturing cost of the lead-acid battery

pack designed for the NTEV program was estimated at \$1,470, with a predicted lifetime of 30,000 miles. Most electric-vehicle makers, including General Motors, estimate similar numbers today (battery cost has fallen, but inflation has risen). Lower maintenance costs would somewhat offset the expense of new batteries, but the requirement is still a disincentive to buyers.

Still, electric-vehicle technology has improved enough so that a viable car can be made today. Though there was only scattered work on electric vehicles in the 1980s, the key technologies advanced for other reasons, especially the surge in demand for better industrial motors and high-power electronics.

The electric motors used in the NTEV prototypes and others of the era were heavy and difficult to cool. They were inefficient, put out little power, and required too much maintenance. Modern motors have gotten lighter, more reliable, and more powerful. Internal energy losses and friction have been reduced, and cooling systems are more effective.

The electronics needed for motor *control* have also improved since the 1970s, driven largely by advances in industrial-automation technology. The job of an electric motor controller is to efficiently deliver the proper amount of current to the car's motor and to transform the fixed voltage provided by batteries into the variable voltage that the motor requires. In the late 1970s, technology for accomplishing this task was primitive, inefficient, unreliable, and expensive, contributing greatly to the NTEV's problems.

The power semiconductors and design methodologies used for motor control improved dramatically in the 1980s, as integrated circuits replaced systems made with discrete components. Widespread demand in the industrial-automation market drove down cost. These advances have enabled electric-vehicle engineers to make sophisticated, highly reliable motor-control circuits at modest expense: a mass-produced electric automobile's motor controller might cost \$1,000 today. In the days of the NTEV, such designs couldn't be bought at any price.

Another technical improvement that is important but less apparent has also occurred since the time of the NTEV. Lighter, stronger alloys and composite materials, and better designs for crash-resistance, have cut the weight of cars significantly. Although consumers were worried about the safety of smaller, lighter cars when they were first widely introduced in the late 1970s, numerous studies have since proven them safe, and the public has come to accept them. The recent inclusion of air bags in many models has further enhanced the safety of small vehicles. Because every pound that can be shed extends the range of electric vehicles, lower weight is critical to performance and is a major factor in their present viability.





## Batteries: The Achilles' Heel

So far the electric car looks pretty good, but there's a catch—the batteries. Though better than in the late 1970s, batteries still cannot store nearly as much energy, or generate as much power, as internal combustion engines. They also have a limited lifetime and take a long time to recharge.

Two measures can be used to compare batteries and conventional engines. The first, power density, indicates the amount of power per kilogram of battery weight that can be extracted from a battery. Insufficient power density reduces a vehicle's acceleration and ability to climb hills, and slows recharge time. The second, energy density, measures the amount of electrical energy that can be stored in each kilogram of battery. Low energy density translates into reduced range between recharges.

A simultaneous analysis of power density and energy



**E**lectric vehicles are indeed on the road again, and in growing variety. Mom's Taxi (above) is a Volkswagen Rabbit converted to electric drive by Marianne Walpert of Belmont, Calif. Its fuel gauge looks conventional but measures the charge of the "Voltsrabbit's"

batteries. Some commercially available EVs, designed electric from the start, are shown on the opposite page: (1) Volkswagen Chico, (2) General Motors Impact, (3) LA 301 made by Clean Air North America, and (4) Fiat Panda Elettra.





density shows the huge advantage of internal combustion engines over batteries (*see the chart on page 58*). Modern engines have a power density of about 400 watts per kilogram, and an energy density well above 200 watt-hours per kilogram. The figures for batteries are dismal: conventional lead-acid batteries, have a power density of less than 100 watts per kilogram and an energy density of less than 40 watt-hours per kilogram.

The advanced lead-acid batteries used in GM's Impact are better, but still fall far short of engines. Other, more experimental batteries—such as lithium, sodium-sulfur, nickel-zinc, and nickel-iron—have better power and energy densities than lead-acid, but they may not be practical for mass-produced electric cars because they are either more expensive, less reliable, harder to maintain, or in some cases dangerous (because their contents are toxic).

Although the power density of batteries is low compared with engines, it is good enough for typical driving.

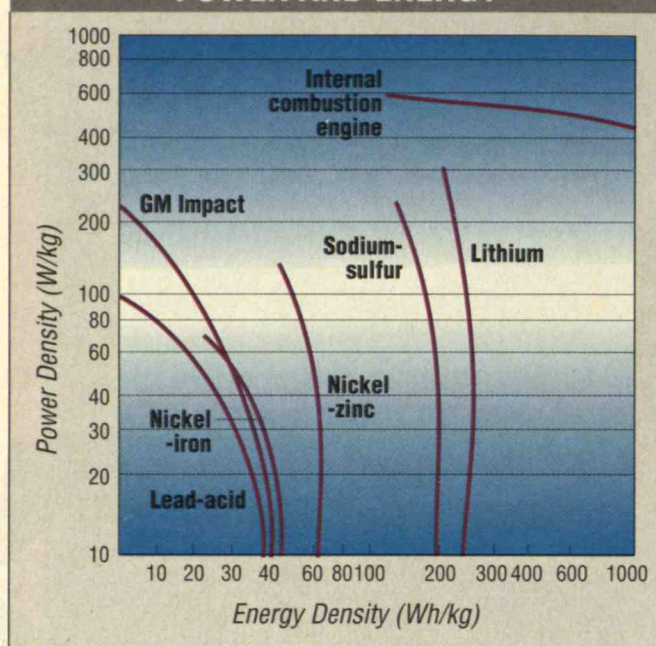
GM, for example, is using lead-acid batteries with a power density of 200 watts per kilogram, yet the Impact has an exhilarating acceleration of 0-to-60 miles per hour in just 8 seconds—better than many sports cars. The Impact proves that even lead-acid batteries have enough power density for responsive driving if they are used in a lightweight, aerodynamic vehicle fitted with low-friction tires and efficient motors and controls.

Low power density, however, in combination with the modest electric power delivered to households, does slow the rate at which batteries can be recharged. It generally takes 6 to 8 hours to recharge fully depleted lead-acid car batteries. Compared with a two-minute gasoline fill-up, this delay seems cumbersome indeed.

Energy density, too, remains a problem. The best electric vehicles go only 120 miles or so before the batteries are fully depleted. Although the typical American commutes only about 20 miles a day, this limitation is both a practical and a psychological nuisance.



## POWER AND ENERGY



**B**atteries and internal combustion engines can be compared in a two-dimensional graph known as a Ragone plot. Engines (upper right) derive much more power from a kilogram of gasoline than batteries can supply per kilogram of their own weight. Lead-acid batteries (lower left) have the

least amount of power and energy of the major battery types being considered for electric cars. But because options such as nickel-iron, nickel-zinc, sodium-sulfur, and lithium batteries are more expensive, unreliable, or unsafe, lead-acid batteries remain the present choice.

The low energy density and long recharge time of conventional batteries has convinced many electric vehicle developers to target cars for fleet use. Most fleet vehicles travel short distances along identical routes every day and are not used at night, allowing plenty of time for recharging. The economics of electric cars also favors fleet owners, who can invest more money than most individuals in the original vehicle and battery replacements if they can realize long-term savings in maintenance and energy costs. Nevertheless, many commuters also take short, identical routes every day to work, and the commuting car is often not used for other purposes. This commuter market is substantial and will be another likely target of the large auto companies that plan to sell electric cars.

To improve range, some carmakers are experimenting with hybrid vehicles—electric cars that also have a small gasoline engine or fuel cell on board. (Fuel cells, used for many years in the space program,

convert chemical fuel into electricity at up to 50 percent efficiency with no moving parts.) The idea is to use battery power when driving in the city, then switch to the engine or fuel cell on the highway; such a setup can easily extend vehicle range by 100 miles or more. In addition, excess power from the engine or fuel cell can be used to recharge the batteries while the car is cruising on the highway.

Several automakers, including GM, Volkswagen, Audi, Mercedes-Benz, and the British-Swedish consortium Clean Air Transport, are working on internal-combustion hybrids, even though they are more complex, less reliable, and more costly than electric cars. Prospects for hybrids that use fuel cells are better. A modern fuel cell powerful enough to propel a 2,200-pound car on a typical commute is roughly the size of a bread box. However, the cell requires a fuel-storage system, and here the technology still has a long way to go. The most economical fuel cells consume hydrogen, which demands heavy and expensive equipment for storage. At present, metal hydrides seem to be the best storage technology, and they yield higher energy densities than are available from most batteries.

### Pioneering Commuters

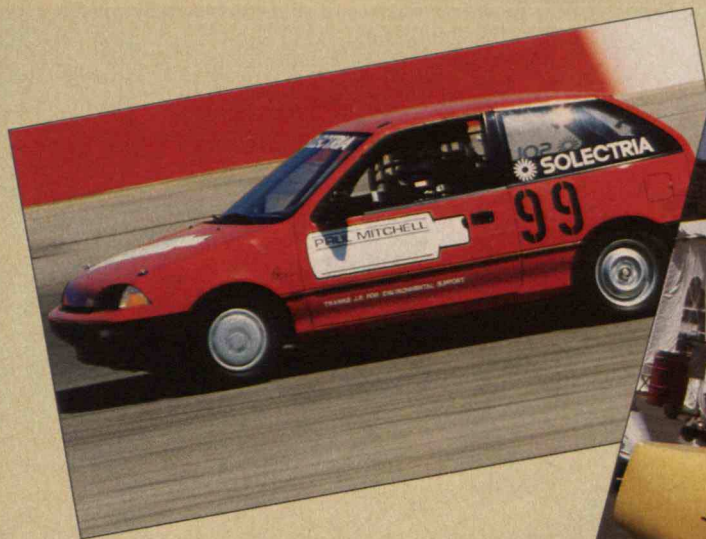
Designers of the Near Term Electric Vehicle program, in their written words, anticipated that “the electric car resulting from this program is to be suitable for future production at a cost comparable to conventional (internal combustion engine) autos.” But they did not appreciate the gravity of the point. The program’s final report in 1980 conceded that a bare-bones electric vehicle could be produced in quantities of 300,000 a year for \$8,520, compared with the \$5,300 price tag for an equivalent gasoline vehicle (in this case, a 1980 Chrysler Horizon TC-3).

Why would a consumer pay 60 percent more for a vehicle with half the range, worse performance, and far more “fill-up” nuisance than a conventional car? The obvious answer is that no one would. Despite interesting technical work, the NTEV’s most important goal, that of economic viability, was not met.

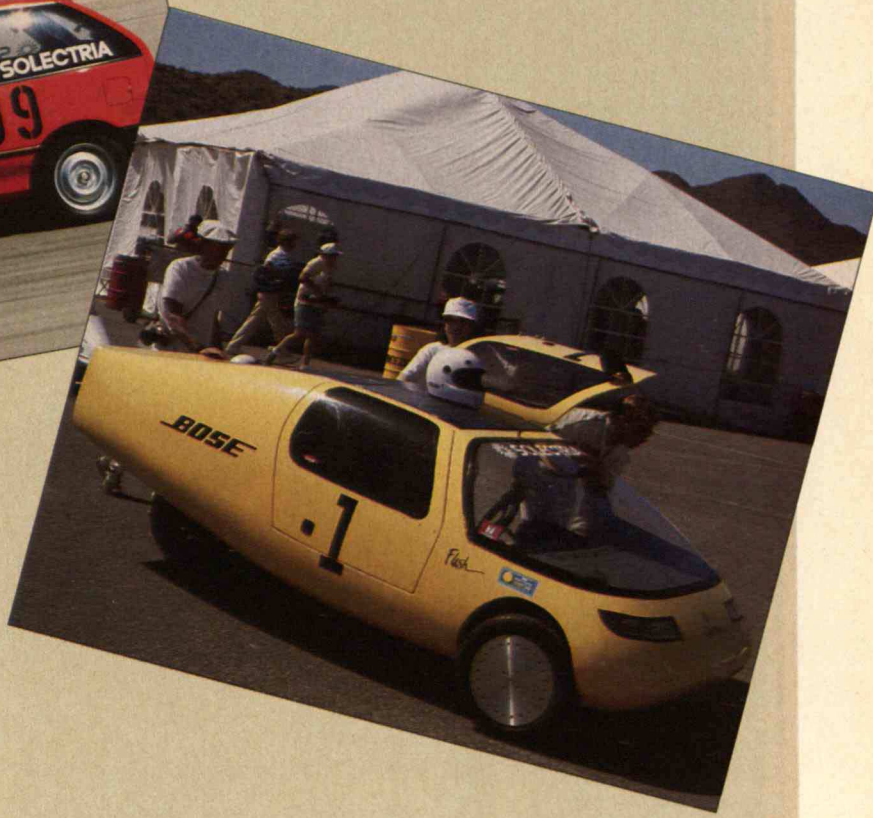
Since that time, changes in perspectives combined with technological advances have made electric vehicles more attractive. Pollution and global warming are considered much more threatening problems than in the 1970s. Modern electric vehicles are more efficient, better performing, more reliable, and cost less. And the public now accepts lightweight vehicles as safe to drive. But until a battery breakthrough occurs, the range of electric cars is unlikely to be substantially extended.

Nevertheless, General Motors expects people will buy the Impact. The automaker’s optimism is based on something never considered by the NTEV program: the





**T**he Solectria Flash (in yellow) is a two-passenger electric racing vehicle constructed of advanced composite materials. It finished first in the lightweight open-competition division of the 1992 Arizona Solar & Electric 500. The Solectria Force (in red), a converted Geo Metro, was the first-place winner in the electric stock-car category.



car is fun to drive! By designing a sporty electric, GM has added the psychological value of high performance to the electric vehicle's balance sheet of perceived worth. Present gasoline models demonstrate that many drivers are willing to spend \$10,000 extra for the thrill of driving to work in a sports car. Though GM won't discuss price, auto analysts have said the Impact will cost between \$20,000 and \$30,000, which is in line with other high-performance cars.

Although the sports car market is not as large as that of standard models, it can still yield production economies, particularly with modern, small-scale, flexible manufacturing. As more cars are sold, the price will come down. And, for the environmentally conscious, there is added incentive for buying electric sports cars: they need no longer worry about having fun at the earth's expense. The Impact is both powerful and environmentally friendly.

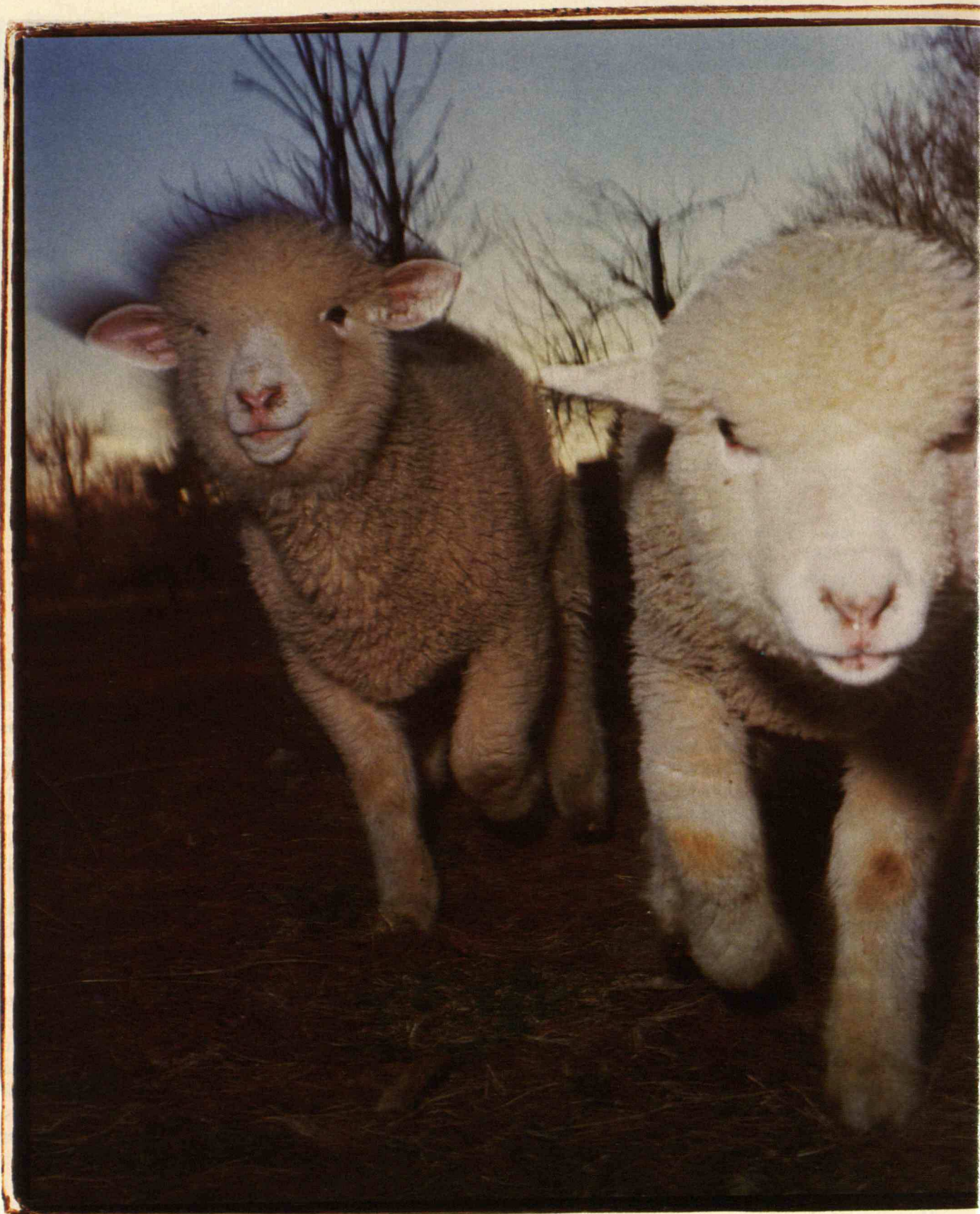
Other measures, such as tax credits or pollution penalties, would help make electric cars more competitive. The development of infrastructure would hasten consumer acceptance: for fast charging, most households would require a modified electrical hookup; and placement of chargers at company parking lots and public garages would roughly double the lifetime of a

commuter car's batteries by preventing them from being deeply discharged (batteries last longer if they are only moderately depleted between charges). For this system to work, though, debit-card or electronic-funds transfer systems would be needed to bill customers who use the charging stations. Ready availability of replacement parts, a network of shops that can change battery packs, and mechanics trained to fix electric cars would also be necessary.

In California at least, where electric cars will be mandated by law, all these measures are being developed by local utilities and municipalities in conjunction with car-makers. A few experimental charging stations have been set up in Los Angeles, and the city is considering economic incentives such as credits for local buyers. And California is not alone. Several other states, including New York, have also passed laws requiring carmakers to include electric vehicles in their local product lines.

Realizing the promise of the fleet and commuter markets—both well into the millions—thus seems closer, albeit still not around the corner. In the meantime, although electric cars cost a little more, the pioneering commuters who drive them will work a little harder for the privilege, and we'll all breathe a little easier. ■





PHOTOGRAPHS BY KEVIN LATADY





# Gene Pharming

*Despite numerous hurdles, the idea of producing drugs in the milk of farm animals is attracting interest.*

**A** SMALL group of scientists share an odd vision. They look at a pasture dotted with tranquil, grazing farm animals and see the pharmaceutical factories of the future.

Katherine Gordon and her colleagues at Genzyme Corp. of Framingham, Mass., reported in 1987 that the milk of their genetically engineered mice contained a human protein that dissolves blood clots, called tissue plasminogen activator (tPA). Media interest in the concept of using animals as so-called bioreactors to produce medicines in their milk or blood—dubbed “gene pharming”—has been enormous ever since. At least four companies have announced that they have made or are working on some seven products in transgenic animals. More research is under way, but also under wraps.

In the past year scientists have, for the first time, reported produc-

tion of various therapeutic proteins in livestock. Researchers at Pharmaceutical Proteins Ltd. in Edinburgh, Scotland, have enabled three sheep to yield a biologically active protein, human alpha<sub>1</sub>-antitrypsin. The absence of this protein, a cause of emphysema, is inherited and leads to one of the most common fatal disorders in males of European descent, with more than 20,000 men in the United States affected. Therapy requires 200 grams of alpha<sub>1</sub>-antitrypsin per year for each patient—a demand the present source, human plasma, cannot meet. One of the sheep produced the highest level yet reported for any foreign protein made in milk, 35 grams per liter, making large-scale production of alpha<sub>1</sub>-antitrypsin look possible.

At about the same time, scientists from Tufts University and Genzyme reported that genetically engineered goats had

■  
By

TABITHA

M. POWLEDGE





produced a long-acting variant of human tPA. This same collaboration has also resulted in transgenic mice that secrete into their milk the gene product believed to cause cystic fibrosis (CF). Genzyme is exploring this protein partly because that may be the only way of getting large enough quantities needed for research on developing therapies for CF, the most common fatal genetic disease in the United States.

But there's a catch to the hubbub over gene pharming. "Although everyone thinks it's a very neat feat of technical facility," says Harvey Bialy, research editor of the journal *Bio/Technology*, "the response of scientists has been almost uniformly skeptical" about the technology's potential for widespread practical use. Although technical hurdles remain, the trickiest part could be getting the economics right.

### Putting New Genes in Livestock

Animal genetic engineering for medical purposes has already achieved modest success, with, for example, the development of transgenic mice and rats as models for human disease. Altering the genetic makeup of farm animals seems like a natural step, considering that we have bred them to order for thousands of years. But the engineering of these species by recombinant-DNA techniques has been mostly disappointing. The much greater expense and time involved in breeding livestock has led to far less research on these animals, with a concomitant smaller number of successful transgenic offspring. So far, scientists have tended to find that even when foreign genes merge with the old, they fail to bring forth their customary protein product—or result in animals that are freaks.

In some cases, these problems would disappear if the foreign genes confined their work to tissues or organs where they cannot cause toxic effects. And if the target tissue were a renewable body fluid, the fluid could be withdrawn and the gene product extracted. The animal would become a bioreactor, a whole-organism version of the vats that churn out useful molecules from genetically engineered microbes or mammalian

cell cultures in today's biotechnology factories. But which fluids? The proteins that would be produced don't find their way into urine unless an animal is sick. And blood has serious drawbacks. Either the costly transgenic animal must be sacrificed to recover the blood, or the extractors must confine themselves to infrequent harvests, taking only what the animal can spare. Most animal biotechnologists believe the public would be repelled by a drug from slaughtered animals.

Still, animal blood may be the best place to manufacture some proteins—especially human hemoglobin, which, as the protein in blood that carries oxygen, could serve as a substitute for whole-blood transfusions. Transfusions of pure human hemoglobin, separated

from animal blood, could not only finesse the problem of incompatible blood types, but also, in these AIDS-conscious times, eliminate the risk of disease transmission. So far, one company—DNX Corp., of Princeton, N.J.—has reported that it has genetically engineered pigs to produce human hemoglobin.

Nevertheless, when biotechnologists usually conjure up visions of the animal factory, they are thinking about the organ that defines the Order Mammalia—the mammary gland, which is talented at adding the fancy bits of sugar that human proteins often require to work right. And while milk has shortcomings (only adult females make it, and for limited periods), big animals can produce it in large quantities and it can be made chock-full of a desired drug.

And milk enjoys good press. Who wouldn't want medicine from Elsie the cow?

To enable an animal to produce a drug in its milk, geneticists first create a hybrid gene. They fuse a human gene that makes a desirable protein (read "drug") to a chunk of animal DNA that targets protein production in the mammary gland. Then they inject the hybrid gene into zygotes (early animal embryos), transfer the zygotes into the wombs of foster mothers, and hope.

Just getting the zygotes is a major challenge. In the most common procedure, scientists treat the adult female animal with hormones to force the ovary to release as many eggs as possible, and then fertilize them while they are still making their way toward the uterus. The resulting zygotes are removed surgically.

*Animals could  
become bio-reactors,  
whole-organism versions  
of the vats that churn out  
useful molecules in today's  
biotechnology  
factories.*





Transfer to the foster animal has also been surgical.

But in September 1991, scientists in the Netherlands reported production of transgenic cattle zygotes in the lab instead of in cows. They collected eggs from slaughterhouse ovaries, fertilized them with bull semen that had been frozen, and transferred the zygotes into foster mothers without surgery. The result (from 2,500 eggs that winnowed down to 103 zygotes, which led in turn to just 21 pregnancies) was the world's first transgenic calves. All two of them.

"The whole process is abysmally inefficient at the moment," Alan Smith, research director of Genzyme, concedes. "And that just means it's expen-

sive." At this point, the price tag for a transgenic cow is estimated at \$500,000.

To improve the success rate, Genzyme and others are trying to develop ways of screening zygotes before injecting them into females. "At the moment it's just done blind," Smith says. One way might be to culture the injected eggs beyond one or two cells. Because the cells have not yet specialized, a 32-cell embryo can be split and half popped into the fridge while the other half is analyzed for the gene of interest. The scrutinized cells can no longer be used, but "as soon as you've identified the positive ones, then you can put the other half back into animals," which will in turn produce transgenic





offspring, says Lothar Hennighausen, who coauthored the first gene-pharming paper with Katherine Gordon and now develops model animal bioreactors at the National Institutes of Health.

While screening zygotes can reduce the cost of making transgenic animals, it cannot ensure the efficient production of desirable drugs. The transferred genes may not always produce proteins during the normal lactation period. In many cases, transgenic animals are producing proteins of interest during pregnancy, which can cause lactation to stop too soon, Hennighausen says.

The answer to getting the gene to produce a protein

at the right time relates to the DNA sequences that control the timing of production. Although such sequences have not yet been identified in livestock, they have been found in other species, leading researchers to feel confident that they can also find them in farm animals.

### **Milking Pigs and Rabbits**

Still another problem is determining which animal should be used to produce a drug. Attention has focused largely on the three animals humanity has been milking for thousands of years: sheep, goats, and cattle.

Cattle might seem like the obvious first choice. But



cash cows are not so easy to come by; compared with the other animals, their gestation and development is longer, close to 40 months from conception to lactation. Because of that, as well as the surgery that's been needed and the simple facts that they eat more food and need more space, transgenic cows are much pricier than the alternatives.

NIH's Hennighausen thinks pigs have been unjustly ignored by most researchers. To make a transgenic pig that expresses a foreign protein in milk costs roughly \$25,000, he says, whereas a similar goat costs almost three times as much. Yet a sow with 10 piglets lactates 10 liters of milk every day, far more than a goat. And pigs bear litters of up to a dozen young, instead of the one or two usually produced by sheep, goats, and cattle. DNX estimates that with normal commercial breeding a single transgenic pig could generate a production herd of 100,000 in just three to five years.

Rabbits might even be the animal of choice for some proteins. Rabbits are small, cheap, bear large litters, have short generation times, and are easy to maintain. A large colony would be a management headache, but just a few rabbits, which each give up to a liter of milk a day, could make drugs—such as the blood-clotting factors VIII and IX, in demand to treat hemophilia—needed only in tiny amounts.

The economics of gene pharming present a paradox. The eventual high-volume production will mean very inexpensive manufacturing costs, enabling pharmaceutical firms to make more profit than by producing drugs in other ways. But companies probably won't have sufficient incentive to first make long-term investments in drugs they see as bringing in only marginal gains, says Katherine Gordon, who recently left Genzyme to do consulting. And the markup on new pharmaceuticals is so high that the manufacturing method has little bearing on the retail cost, says Alan Colman, a biologist who helped start Pharmaceutical Proteins.

So the fact that producing a particular protein in milk is—eventually—very cheap isn't a good enough reason to do it. The key is to pick proteins that can't be made in any other way or that can be made only by animal bioreactors in needed volumes. That is why Genzyme has no plans to commercialize its



milk-derived tissue plasminogen activator, a protein already produced in adequate amounts from cell culture. And it is why Pharmaceutical Proteins is pursuing human alpha<sub>1</sub>-antitrypsin (the protein whose absence causes emphysema) and factor IX, which is now available to hemophiliacs only in very limited quantities.

### Making Sure Pharmed Drugs Are Safe

Say you've come up with a drug that can only be produced by gene pharming, and you're willing to invest the time and money. You've selected an animal bioreactor and solved the technological problems of getting the transgenic offspring to lactate properly. One

last issue remains: purifying the therapeutic proteins from the milk and delivering a safe, consistent drug. After all, milk is also stuffed with other proteins and contains enzymes that break down proteins.

Quality control and assurance are particularly daunting aspects of the purity problem. Living animals present sanitation challenges undreamed of by those who make other recombinant-DNA products. For example, will the valuable beasts be permitted to graze in pastures, or must they be kept indoors? Will they have to eat the same thing all the time in order to ensure uniform production?

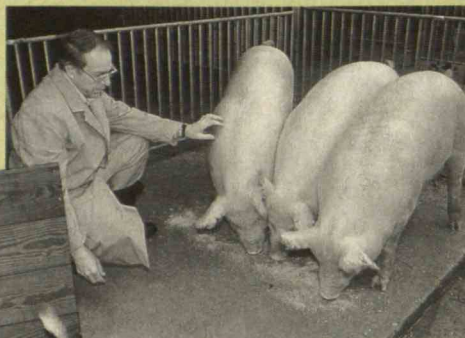
"A problem we have to face is the possible contamination of the product with viruses," acknowledges Colman of Edin-

burgh's Pharmaceutical Proteins. One that is much on his mind is the virus that causes scrapie, a virulent disease of sheep. Thus, he notes, "we're flying in 600 sheep from New Zealand, which is a scrapie-free island, because we're starting a scrapie-free herd to continue our pharmaceutical work."

The regulatory climate could also be a factor. Some observers think that the U.S. Food and Drug Administration (FDA) might want to look particularly closely at novel production methods involving both genetic engineering and live animals. Regulators might want to ensure that the manufacturing techniques don't affect safety and efficacy. But some think that the FDA will not be much tougher on gene-pharmed products than on drugs now made by recombinant DNA tech-

*T*ransgenic  
cows are much pricier than  
sheep, goats, and pigs.  
Rabbits might even be the  
animal of choice  
in some cases.





*The genetic makeup of this goat and two of the pigs includes genes from other species. The goat carries the human gene for producing tissue plasminogen activator, which dissolves blood clots. The pigs carry a mouse gene inserted into their mother to test whether she would manufacture a protein in her mammary gland. She did.*

nology. Authorities might feel comfortable just checking the protein produced by the live bioreactor method, says Gordon. And while the Food and Drug Administration will doubtless look especially closely at the first cases, the agency has been streamlining its process in response to demand for some new drugs. Hennighausen says he can imagine that a protein like the blood-clotting factor VIII or IX would get a friendly reception because of today's limited supplies.

### Next Steps for the Animal Bioreactor

Genzyme's mouse milk production of cystic fibrosis transmembrane conductance regulator (CFTR), the protein believed to be defective in cystic fibrosis, opens up the prospect of a new class of therapeutic molecules. All the other molecules produced so far in animal bioreactors are soluble proteins that, in milk, end up drifting around. But CFTR is one of a group of proteins that reside in membrane and are called membrane proteins. These proteins run a kind of shuttle service for crucial chemicals that need to get in and out of the body's cells.

The significance of Genzyme's CFTR production is that scientists previously have been able to produce only small amounts of membrane proteins before they kill the cell medium in which they're growing, according to Smith, the company's research director. Genzyme came up with the idea of sequestering the membrane containing CFTR from other cells. The mammary gland, as it happens, is an excellent place to try that strategy because its membrane engulfs butterfat globules as they bud off from mammary cells. Eventually the membrane floats away from the mammary cells to become part of the cream.

Although Genzyme has not yet shown that the CFTR it has produced has biological activity, it regards membrane proteins as attractive candidates for future work. Of particular interest are the proteins that transport viruses into cells. If such viral transporters can be developed in quantity by animal bioreactors, researchers may be able to use them to figure out specifically how various disease-causing viruses enter cells. Then scientists can develop techniques to prevent the diseases.

In another new area of research, Pharmaceutical Proteins is considering whether animal bioreactors could make products other than drugs. One idea is to target the thriving market in modified milk; livestock mammary glands might, for example, be an interesting place to produce human infant formula for the many babies allergic to beta lactoglobulin, a protein in cow's milk. Milk from a cow without the gene for beta lactoglobulin could trigger no allergic reactions while providing other important proteins. Researchers have still, however, to remove any gene from the DNA of livestock.

Despite such possibilities, investors have not yet stampered toward the animal bioreactor. The field "hasn't shown huge promise yet," says John McCamant, publisher of the *AgBiotech Stock Letter*. "We're watching it closely, but it needs to be further along before we can get an investment grasp on it."

But the tenacious pioneers of gene pharming continue to show faith in their living, breathing protein factories. The researchers used to find it difficult to convince anybody that they could create animals that produced therapeutic molecules, recalls Harry Meade, who heads Genzyme's animal bioreactor group. "But now there are bioreactors walking around, making a lot of these proteins." ■



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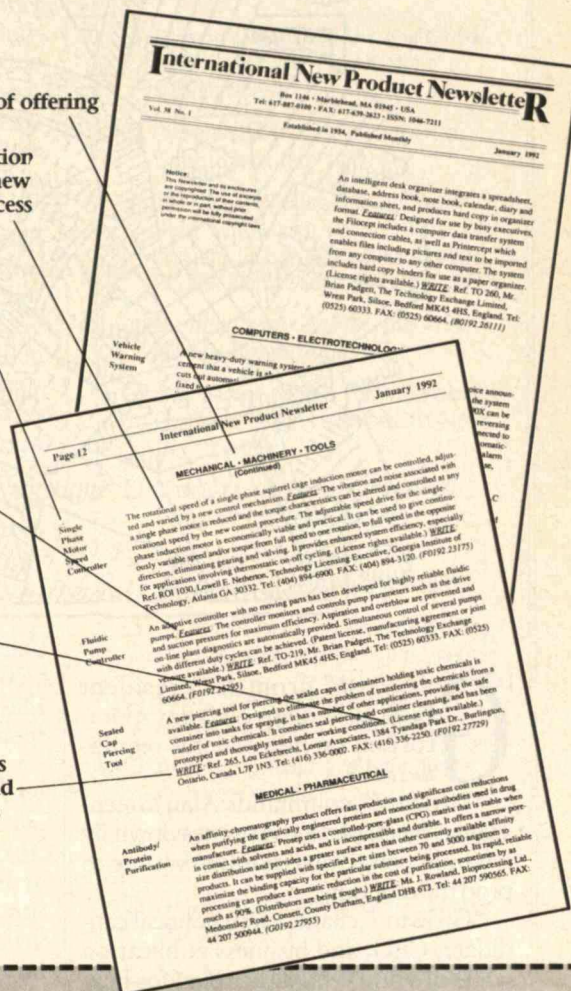
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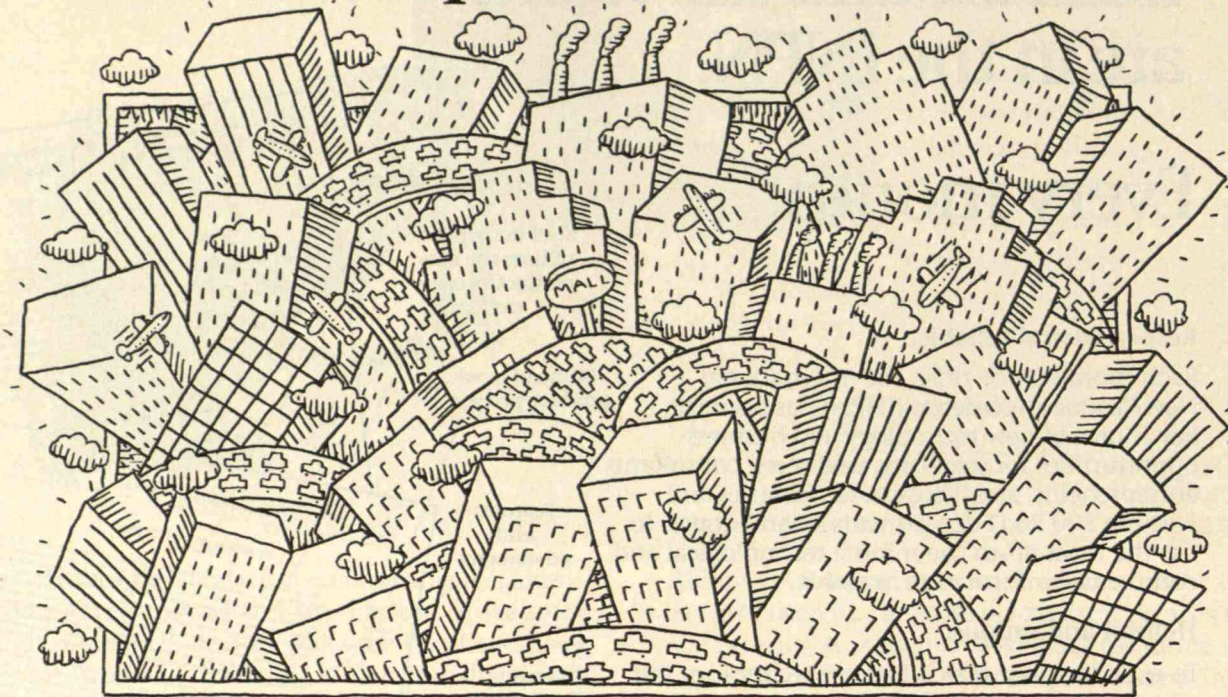
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# Smart Development, Not Dumb Growth



**G**ROWTH!" promises President Bush as he slaps a 90-day moratorium on new federal regulations.

"Growth!" commands Alan Greenspan as he cranks interest rates down by a whole percentage point at a time to prod the economy.

"Growth!" chants every political candidate, CEO, and business publication while offering yet another plan for how to generate it.

Tax cuts for the middle class or on capital gains. More free trade or less free trade. More borrowing or more budget-balancing. Do something, anything, to prime the pump of growth.

Some of these ideas may be worthy but none will "jump start" the economy, and that's a good thing. Jump-starting is not what's needed. The recent U.S. history of cranking up growth at any cost got us into this economic pickle in the first place.

Take my home state of New Hampshire. When George Bush visited us during the 1988 primary, our economy was experiencing a wild boom. Property values were rising 25 percent per year, drawing speculators from the entire

*A strong  
and sustainable economy  
is big on the better  
and light on the  
bigger.*

Eastern seaboard. Banks were lending full-out; developers were carving up forests and fields. You couldn't hire a carpenter or a dozer operator: they were all working overtime building condominiums and up-market malls.

It took nothing more than common sense to ask back then: Who will live in these condos? How many people will shop in those stores? What will happen when the growth in real estate prices slows down and the smart money drains back south? How will the bank loans be paid? How will this army of construction workers stay employed?

Now the condos stand unsold, the banks totter, the unemployed move out of New Hampshire in droves. The fields

and forests that were paved over yield no rent and also no firewood, corn, or hay. We don't need another round of dumb growth like that. What we need is smart development.

Smart development builds on a region's unique skills and resources and encourages durable local businesses. Dumb growth entices a big corporation, which brings in money from outside, exerts control from outside, drains profits back outside, undercuts local manufacturers, and lays off hundreds without warning.

Smart development produces things people actually need, and does so with high quality. Dumb growth produces a tinsel product people have to be seduced into thinking they want—until times get tough, when it's the first thing they stop buying.

Smart development means using investment money and construction skills to maintain the roads, bridges, and buildings you already have before you build new ones. It means educating people and protecting their health. Dumb growth disregards those kinds of investments because they don't pay off visibly enough or soon enough.



Smart development invests in insulation, efficient cars, and ever-renewed sources of energy. It ensures that forests and fields continue to produce wood, paper, and food, recharge wells, control floods, harbor wildlife, attract tourists, and please residents. Dumb growth crashes around looking for more oil. It clearcuts forests to keep loggers and sawmills going just a few more years until the trees run out. It waives environmental regulations as long as the cleanup costs can be put off on the public or into the future. It covers the landscape the tourists come to see with the same kind of honkytonk ugliness they leave home to escape.

I could go on with this list and so could you. Drawing a distinction between sustainable development and unsustainable growth doesn't mean being soft-headed or anti-economic. It means being practical and sane, creating an economy that doesn't delude itself with booms that create their own busts, or with drawing down and polluting the resources of the earth upon which all economic activity depends.

With the aid of a dictionary, World Bank economist Herman Daly once noted a crucial distinction: "TO GROW means to increase in size by the assimilation or accretion of materials. TO DEVELOP means to expand or realize the potentials of: to bring to a fuller, greater, or better state. When something grows it gets quantitatively bigger; when it develops it gets qualitatively better. Quantitative growth and qualitative development follow different laws. Our planet develops over time without growing. Our economy, a subsystem of the finite and non-growing earth, must eventually adapt to a similar pattern of development."

The only problem I have with that quote is the word "eventually." Both the U.S. and the world economy have already reached and surpassed their sustainable physical limits. We are drawing down groundwater, eroding soils, cutting forests faster than they replenish themselves, catching fish faster than they reproduce, burning nonrenewable fossil

fuels without developing substitutes, and overloading the parts of the planet we use as waste receptacles, from landfills to the atmosphere. Just as New Hampshire builders overshot the sustainable market for houses and stores, so the entire economy has overshot the rate at which the earth can sustainably provide resources and process wastes.

The economic overshoot that caused the present recession and the environmental overshoot that is visible in declining resources and rising pollution are dissimilar in many ways — above all in the different time-scales with which they will work themselves out. But underlying any overshoot are three common factors.

First is rapid growth. Second is some sort of limit beyond which the growth cannot be sustained. Third is an information problem. Because of inattention, faulty data, delayed feedback, slow response mechanisms, or plain denial, the growth is not reigned in as it shoots by the limit. It goes too far, until the bills come due and a serious retrenchment becomes necessary.

Recognizing this need, we have two choices, and neither of them is to grow. We can let the limits themselves stop us, in their own time and with complete indifference to our own values and priorities. Or we can purposely slow down, ease back, become less wasteful and more efficient, heal the damage, and preserve what is most important to us. We will discover, if we choose the second option, that after our rather simple physical needs are met, what is important is mostly qualitative, not quantitative. We can't grow indefinitely, but we can go on developing indefinitely.

We need to meet dumb growth schemes with smart questions. What really needs to grow? Who will benefit? Who will pay? What will last? ■

DONELLA H. MEADOWS is adjunct professor of environmental studies at Dartmouth College. She co-authored *Limits to Growth* and, recently, *Beyond the Limits*, with Dennis Meadows and Jørgen Randers (Chelsea Green Publishing Co., Post Mills, Vt.).

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# Grad Students: An Endangered Species?

FEDERAL auditors are proposing to change the rules for how universities charge the government for research costs. Though it's easy to dismiss the ensuing controversy as an arcane dispute about accounting methodology, one change being considered by the Office of Management and Budget (OMB)—involving the tuition of graduate students who are preparing a dissertation under a federal grant—threatens major damage to U.S. science and engineering.

The typical science or engineering grad student devotes half-time to research and half-time to coursework and a dissertation. The student's stipend plus tuition roughly equals the stipend of a postdoctoral researcher—who devotes full time to research. Not surprisingly, professors faced with this choice are tempted to hire postdocs instead of relying on grad students. By the early 1980s, it was evident that the number of postdoctoral researchers was growing, many of them from overseas, while the graduate student population remained flat.

In 1984, MIT, Stanford, Caltech, and other universities took action to reverse this trend. These schools now charge grad student tuition as an "employee benefit" to an overhead account shared by all faculty researchers. This makes graduate students much less expensive than postdocs to the professor's research grant. At MIT, the result has been a 40 percent growth in the number of graduate students since 1984, while the postdoctoral population has stayed the same.

Under this system, the federal government is still bearing the full burden of graduate student tuition. The difference is that now the costs are more evenly distributed within the university. In effect, departments that use few graduate students are subsidizing departments that use many; at MIT, for instance, Lincoln Laboratory and the Plasma Fusion Center, which rely on postdocs and professional research staff, subsidize the chemistry, physics, and electrical engineering departments.

Federal auditors are uncomfortable with this practice. They invoke the traditional economic principle that to make the most efficient use of resources, costs should be attributed to the activity that generates them. Also, federal program managers argue that if it is in the nation's interest to pay for graduate education, then the subsidy should be directly authorized—not indirectly seized.

Until recently, most managers of federal research programs approved the indirect charging method because the country clearly benefits from it, by producing a larger number of highly trained scientists and engineers. But Congress's current focus on controlling university overhead is overwhelming this longstanding appreciation. (Ironically, House Energy and Commerce Committee chair John Dingell, whose investigations of indirect cost abuses have led to the proposed changes, has never

shortage of graduate students will result in fewer postdocs, who will eventually command such a high price that graduate students will look like bargains. But that isn't much comfort, since it implies fewer postdocs and grad students as well as higher university research costs. And the suggestion by some federal agencies that private universities should bear the tuition cost from their endowments has little appeal, as it would require that money be diverted from undergraduate education or the humanities.

To avoid a potentially mortal blow to the strength of U.S. universities, Congress should explicitly authorize the indirect payment of graduate-school tuition. This would acknowledge the educational value of thesis research and would, in effect, make graduate research assistantships into traineeship programs. Then, perhaps like existing traineeships sponsored by the National Institutes of



attacked the indirect system of paying for grad students.)

If OMB disallows the current practice, the number of science and engineering graduate students at U.S. research universities will fall significantly, perhaps to half the present levels. In the short run, research faculty will hire more postdocs, and, as the pool of U.S. PhDs dwindles, the proportion of these postdocs that are foreign citizens will rise. It may become necessary for universities to start charging postdoctoral researchers an educational fee, which would generate revenue to cover graduate student tuition.

In the long run, some contend, the marketplace will sort things out: the

Health and the National Science Foundation, this tuition benefit would be available only to U.S. citizens.

This is not a sexy issue and it is hard to get our political leaders to focus on it. But ensuring financial support for science and engineering graduate students may be the most important basic research issue we face today. It is certainly a lot more important than the highly publicized debates over which big science projects should get funding. ■

*JOHN M. DEUTCH, Institute Professor at MIT, was formerly provost and dean of science. He has also been undersecretary and director of energy research of the U.S. Department of Energy.*



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## Farewell to Progress

**R**ECENTLY I had an opportunity to view a collection of clips from “progress on the march” movies of the 1950s. Standard fare in classrooms and theaters of my youth, the films celebrated the latest advances in science, technology, and industry. As lush orchestral themes swelled in the background and busy scenes of men and machines appeared on the screen, a forceful male voice would say things like, “What were once disease-infested swamps are transformed overnight to become blocks of luxury homes.”

You could tell it was progress, all right. There were redwood trees falling, mountainsides exploding, cars rolling off assembly lines, smokestacks belching fumes, biplanes spraying insecticides, and men in white coats gazing into test tubes. Shown today in college history classes, such images evoke howls of laughter. What makes the technology promotion films seem ludicrous is that we immediately compare their gossamer-winged dreams with today’s environmental, economic, and social realities. The ideology that inspired the old scripts now seems awfully flimsy.

Faith in progress hinged on the belief that the human condition inevitably improves, primarily through advances in science and technology. This notion arose in the eighteenth century, took root as the dominant belief system of industrial societies of the nineteenth century, and has since been adopted around the globe as a secular, ecumenical faith. Those who embraced this idea saw themselves propelled onward and upward by a process larger than themselves, a beneficent historical dynamism whose destiny was to create a better society, perhaps even an earthly paradise.

This ideology’s appeal flowed not only from its promise of a happy ending, but also from the way it made examination of individuals’ plights unnecessary. There was no need to ask “Has anyone been left out?” for it was assumed that everyone would benefit in the end. There was no need for engineers to weigh the broader consequences of their projects;

people believed that science and technology would take care of whatever unanticipated side effects might occur.

While remnants of this belief remain in contemporary political talk about economic growth, the idea of progress is rapidly fading from public rhetoric. The old images have lost their savor. Seriously in jeopardy, for example, is the expectation that the next generation will necessarily achieve a better standard of living than the present one. American and European young people face the bitter prospect that they may never be able to afford the same level of material comforts that their parents enjoy. Buying a home, once virtually guaranteed to any U.S. wage earner, is becoming an elite privilege. While politicians like to portray these signs as temporary aberrations connected to the recession, the suspicion grows that the real problems are endemic.



The notion that people’s lives inevitably improve is fading on a global scale as well. In much of the developing world, economic development during the past decade has simply stalled. Mounting social and environmental problems, along with growing recognition of the unequal distribution of the world’s wealth, have rendered the promise of modernization a cruel hoax. Some Third World nations now regard “technology transfer” from the industrial nations less as a blessing than a curse—and suggest that it is money, not technology, they want transferred.

There are still, of course, many ways in which creativity and invention are

helping to better the human condition. But improvements are now seen as partial, isolated, and double-edged; they are understood to be good for some, but not for others. There is growing recognition that some of the damage wrought by industrialization may never be repaired at all. What if the ozone layer recovers only as well as the Bronx? Such perceptions reflect a loss of the conviction that once gave modern society its sense of mission. That loss haunts the end of the twentieth century.

It is not clear what pattern of beliefs will arise to fill the void. Television ads, industrial trade shows, and campaign speeches will no doubt continue to recycle progress themes in ways that seem ever more cynical. Those who think seriously about the choices in science and technology policy must transcend the hype to ask: Given what we know about the wider circumstances and effects of

our work, how are genuine improvements ever secured? Progress for whom? For how long? At what cost?

Quietly vanishing, once and for all, is belief in a necessary link between scientific and technical advance on the one hand, and the well-being of the earth and its people on the other. Because the outcome is no longer guaranteed by quasi-divine dispensation, extraordinary care is required as we struggle to connect the two kinds of improvement. ■

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# Reviews

BOOKS

## BAILOUTS AND BUREAUCRACY

*Losing Time: The Industrial Technology Debate*  
by Otis L. Graham, Jr.  
Harvard University Press, \$29.95

BY RAYMOND VERNON

**I**N January 1980, the U.S. government rescued Chrysler from imminent bankruptcy with \$1.5 billion in loans. And in the four years following, as the U.S. economy faltered, the country debated furiously the merits of maintaining an industrial policy—that is, of systematically helping other companies, even whole industries, as it had helped Chrysler. That controversy, writes Otis L. Graham, Jr., in *Losing Time: The Industrial Technology Debate*, has far from ended. Given the current struggle over the handling of the savings-and-loan scandals and over the country's need for "national economic security," one can hardly doubt his assumption. Although the lines of the debate have grown much more complex, the struggle over how the government should use its powers to shape industry will not go away.

The debate itself, as Graham recounts, has produced some consensus regarding a few central facts. There is little doubt among the principal debaters, for instance, that the U.S. technological lead has slipped in recent decades, and there is some agreement that U.S. public policies have had something to do with the slippage. Yet the range of opinion on what should be done about it runs an extraordinarily wide gamut, reflecting differences both in diagnosis and in prognosis.

Some see the slippage as modest, an inevitable correction of the enormous technological lead of U.S. industry after World War II. But some see it as a pre-



cursor of the utter ruination of the U.S. economy. For some, the forces involved are quite impersonal, the result of an inescapable international diffusion of knowledge and skill. For others, the slippage is a consequence of the superior public policies of Europe and Japan, policies that recognize the need for a concerted national response to technological challenges. And for still others, the slippage results from the predatory acts of other countries, especially Japan and Korea, engaged in a game of economic warfare that promises in the end to subjugate the U.S. economy.

The author, a professor of history at the University of California at Santa Barbara, does not much help the reader to choose among these rival camps. Instead, he seems bent on demonstrating two things: that participants in the debate commonly have had little concern for the historical facts, and that such a concern would have facilitated the search for a national policy. Much of the story of the debate is told by paraphrasing the arguments of the more articulate debaters, such as Robert Reich, William Diebold, Lester Thurow, Robert Lawrence, Clyde Prestowitz, Charles Schultze, and John Glenn. But the author, playing the role of historian,

remains determinedly above the fray. As a result, although the book provides a reliable account of the debate, it falls short of providing the materials for appraising the relative merits of the various positions.

The industrial policy debate that started in the 1980s is, as the book well recognizes, only the latest phase in a controversy that dates back to Alexander Hamilton. Through tariffs, subsidies, and other measures, the United States has been promoting individual industries from the start. But the form and content of such support in the United States have differed profoundly from those encountered in most other industrialized countries. And what most U.S. readers need to understand is the depth of the differences that distinguish the United States from Europe and Japan as they address the use of governmental power in shaping national industry.

Unfortunately, the reader who wants to grasp the full magnitude of those differences will have to turn to other sources.

### Curbs on Government Power

If there is one key factor that differentiates the United States from other countries in its efforts to influence industry structure, it is the role that Americans accord to their professional bureaucracy. As historians never tire of telling us, the structure of the U.S. government was carefully designed to check and balance the use of public power, not to create a public instrument of precision, consistency, and efficiency. In the long history of U.S. administration, the popular demand to curb the power of the professional bureaucracy has been a persistent leitmotif. That power has been curbed in numerous ways: by staffing the top layers with political appointees responsive to the party that occupies the White House; by devising elaborate administrative procedures to be followed before any decision is taken; and by making extensive provisions for appeal and reversal of any decision. These provisions have been all of a piece with the widely held convic-



tion that good public administration requires honesty and responsiveness more than expertise.

To be sure, those values have not proved to be a bar to U.S. measures that boost one industry or another through public action. Nor have these measures always missed their mark. Harley-Davidson's emergence as a premier producer of motorcycles took place behind a temporary shelter from Japanese imports. And the apparent revival of the U.S. steel industry in the 1990s occurred after 25 years of special protection that the industry managed to squeeze out of the U.S. government. But cases in which such special measures have been misdirected and ill-conceived appear to have been extremely common. Restrictions on the importation of automobiles and semiconductors, for instance, probably hampered U.S. industry more than they helped.

Some Americans believe that any effort by the U.S. government to rescue an industry from disaster is bound to fail, the outcome being guaranteed by a special deity with a twisted sense of humor who presides over such matters. My own explanation for the frequency of such failures is quite different.

In my view, Americans find themselves pursuing two laudable objectives that are on a collision course: to diffuse governmental power among many different institutions, yet to pursue public policies that are relevant, consistent, and sustained. When the government singles out one interest group, the ensuing cries of favoritism often lead to successor policies that are no more broadly based than those they displaced. Or, as in the Chrysler bailout, the process of obtaining government assistance may be so tortuous and prolonged, and so smothered by administrative requirements, as to imperil the whole operation. Such outcomes cannot be avoided as long as Americans seek to maintain the existing balance between checking bureaucratic tyranny and generating effective governmental decisions.

In the past few decades, the importance of finding the right balance has grown considerably with the changing

position of the U.S. economy. Those changes, as Graham acknowledges in a characteristically oblique aside, include greatly increased interdependence in a world that does not share American values regarding the balance between power and efficiency. As a historian, the author is entitled to his final observation: that history has a habit of providing solutions to problems that seem insoluble. Meanwhile, however, politicians and special interests can afford no such measure of detachment, and the battle over industrial policy in the United States is bound to continue. ■

RAYMOND VERNON is a professor of international affairs emeritus at Harvard University. Among his many book credits is the forthcoming *Defense and Dependence in a Global Economy* (Congressional Quarterly Press), of which he served as editor.

## BOOKS

## MISREADING NUCLEAR HISTORY

*Closing Pandora's Box: Arms Races,  
Arms Control, and the History  
of the Cold War*  
by Patrick Glynn  
Basic Books, \$30

BY GERALD M. STEINBERG

**A**LTHOUGH Patrick Glynn served as special assistant to the director of the Arms Control and Disarmament Agency during the Reagan era, he had no interest in the substance of arms control. Like many of his colleagues, he viewed efforts to negotiate limitations on the development and deployment of nuclear weapons as the product of naive liberalism. This mindset, associated with Democratic politicians, was far removed from the realities of international politics and modern warfare as Glynn saw them. Soviet leaders

exploited liberals' naiveté, knowing that they could evade the terms of agreements while the United States and the West could be counted on to abide by them.

*Closing Pandora's Box* is a detailed and well-written defense of this perspective. In his opening essay, "The Sarajevo Fallacy," Glynn refutes the oft-repeated argument that World War I resulted from a naval arms race that spiraled out of control (he blames German imperialism and militarism instead). And like most other analysts, he believes that World War II could have been avoided had German rearmament been forcibly opposed through a corresponding Allied buildup. His main argument is that arms races do not cause wars and that arms control is not only unnecessary but even dangerous.

The historical background of the world wars forms the basis for Glynn's analysis of the Cold War and the role of arms control in U.S.-Soviet relations. He argues that the events of 1914 and 1939 prove that only a continuous show of strength and the demonstrated willingness to use all weapons, including those in the nuclear arsenal, can guarantee American national security. Politicians, he asserts, have ignored these basic "truths" and instead pursued appeasement, in the form of arms control. These efforts were signs of weakness that ultimately strengthened the Soviet Union and heightened the prospects for war.

Like other ideologues who influenced military policy and arms control during the Reagan era, Glynn rejects the premise on which postwar arms control has been based: that nuclear weapons have changed the rules of warfare and the nature of international politics. According to this prevailing view, the horrors of nuclear explosions, with their ability to destroy cities and devastate entire civilizations in a few seconds, have made arms control necessary for the survival of all states. In a nuclear exchange, it is reasoned, there are no winners, and political conflict between nuclear powers must be tempered by the common interest in survival.

Glynn, however, avoids and trivializes these difficult issues. In his analysis, the



world is divided between forces of good and evil, and there are no accidental wars. Choosing the evidence carefully to conform to his ideology, Glynn rejects the view that the United States might have been able to prevent the nuclear arms race and the Cold War. Stalin's totalitarian and imperialist policies, the author maintains, doomed any prospect for cooperation, including arms control.

Yet analysts such as Martin Sherwin, author of *A World Destroyed: The Atomic Bomb and the Grand Alliance*, have demonstrated that by shunning Stalin and using its atomic monopoly as a source of political and military pressure, the United States forced the Soviet Union to seek its own nuclear arsenal. Unable to refute such arguments by presenting any new information, Glynn leaves us with his opinions but little more.

Much of the remaining analysis focuses on other "naive liberals," from Robert McNamara to Jimmy Carter, and on the scientists who in many ways were the founders of nuclear arms control. Herbert York, who headed Livermore National Laboratory, where thermonuclear weapons were developed, has argued that U.S. restraint in the development of these weapons might have at least slowed the Soviet effort and perhaps provided an opportunity for mutual restraint. Glynn rejects this view. But instead of offering substantive discussion, he simply states that "somewhat characteristic of a scientist, York confuses the scientific reality with the political one."

Similarly, George Kistiakowski, who served as President Eisenhower's science adviser, is castigated for excluding the defense secretary and the head of the joint chiefs from a presidential briefing on advanced weapons and arms control. Glynn seems to have forgotten that it was Eisenhower, the former head of Allied forces in World War II, who warned of the dangers of the "military-industrial complex." It was he who often found the military chain of command to be incapable of dealing with modern technology and concerned with parochial interests. And it was he who sought to discuss these concepts free of the interests and ideolo-



gies of the military leadership. Despite Glynn's best efforts, it is clear that nuclear arms control is not simply the province of "naive liberals."

The analysis is on firmer ground in the chapters on the Strategic Arms Limitation Talks and the SALT I and ABM treaties signed in 1972. As Glynn notes, Nixon and Kissinger, who negotiated these agreements, trustingly believed that the Soviet leadership shared their interest in stability and in slowing the nuclear arms race. In SALT I, the United States even allowed the Soviets to maintain a lead in the number of ICBMs.

As Glynn reminds us, the treaties did not slow the pace of Soviet nuclear development. Within a short time, the military leadership in Moscow had begun to deploy a new generation of highly accurate ICBMs, along with intermediate-range mobile missiles in Europe. These were perceived as highly destabilizing, and could best be used in a first strike to prevent the United States from mounting a massive retaliation. Such evidence demonstrates that the leaders in the Kremlin did indeed use arms control agreements as a means for seeking unilateral advantage, and not for developing mutual interests.

But Glynn draws the blanket conclu-

sion that this Soviet proclivity nullified any possible benefit for the United States from arms control. On the contrary, the Soviet tendency to take advantage simply meant that in negotiations it was necessary to stipulate equal levels of strategic forces. Indeed, this became U.S. policy, as adopted in the 1972 Jackson Amendment and negotiated in the SALT II and Intermediate-Range Nuclear Force agreements. Arms control continued, with benefits for U.S. policy but without allowing the Soviets to claim strategic superiority.

According to Glynn, the United States and the West were saved from disaster by Ronald Reagan and the Strategic Defense Initiative. Under Reagan, the U.S. government finally saw the true nature of the Soviet Union as an "evil empire" and acknowledged the folly of arms control negotiations. Resisting what he saw as naive and highly dangerous calls for a nuclear freeze and for scrapping the MX missile, Reagan proposed SDI. It was this initiative, Glynn argues, that forced the Soviets out of the arms race and led to victory in the Cold War.

Perhaps the Strategic Defense Initiative did play a role, but the Soviet economy was on the brink of disaster when Gorbachev took over, and Glynn presents no evidence that the results would have been very different without SDI. Indeed, critics argue that Reagan's massive defense spending, including that on SDI, did immense damage to the U.S. economy—a charge that Glynn ignores.

In the nuclear era, the issues of war, peace, and arms control cannot be reduced to a simplistic formula or ideology. When conflict and escalation, whether deliberate or accidental, can lead to mutual assured destruction, all leaders have a stake in avoiding suicide. Glynn's efforts to dismiss these policies cannot erase the fact that arms control, in combination with deterrence, succeeded in preventing the use of nuclear weapons during the Cold War. ■

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## BOOKS

## GIVING AN INDUSTRY MORE THAN IT BARGAINED FOR

*Numerical Control: Making a New Technology*  
by J. Francis Reintjes  
Oxford University Press, \$39.95

BY JOHN I. MATTILL

**N**UMERICALLY controlled machine tools, essential for manufacturing the host of products that depend on precisely shaped metal parts, originated in the United States. Today most bear the stamp "Made in Japan" or "Made in Germany." So it is that the national debate on the competitiveness and productivity of American industry has shined onto numerical control (NC) an analytical spotlight that seldom pierces the darkness covering such complex, almost invisible technologies.

The first to turn the spotlight of controversy on NC was historian David F. Noble. In *Forces of Production: A Social History of Industrial Automation* (1984), Noble argued that MIT electronics researchers, who had essentially no background in building or operating machine tools, developed NC systems in the 1950s that were too complex for routine applications. Such decisions, he maintained, weakened the industry and fueled its demise at the hands of overseas competition in the 1970s.

*Numerical Control: Making a New Technology* provides a detailed history of this project and represents an overdue response to Noble's analysis. Though not involved in the first stages of the MIT work, author J. Francis Reintjes became director of the laboratory in which it was being conducted, and he is a clear-thinking partisan of it. His language cannot match Noble's for color and exhorta-



tion, but—given that he is an engineer with no track record of writing about the field for a lay audience—Reintjes's achievement is a pleasant surprise.

### The Need for Precision

The story begins at the end of World War II, when the U.S. Air Force began planning a new generation of high-performance aircraft and concluded that their manufacture would require complex new machine tools. Enter John T. Parsons, an enigmatic machinist-turned-entrepreneur who in 1949 was vice-president of the Parsons Corp., a small machine-tool maker in Traverse City, Mich. Parsons knew that information stored on punched cards could be converted into sequences of digital signals, and he interested the Air Force in a concept for a self-directing milling machine: through instructions on punched cards for cutting and drilling operations, the machine would run without human guidance.

To ensure that the system could meet Air Force requirements for precision, Parsons turned to MIT, where pioneering work had been done on feedback control systems—servomechanisms—during the war, to improve the accuracy of artillery and antiaircraft fire.

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The Servo Lab, in which MIT's post-war ambitions for this work were centered, found Parsons's problem interesting. It estimated that the required system might take a year of work and cost \$25,000—a proposal that quickly won Parsons's blessing and the Air Force's funding.

But the Servo Lab, perhaps because it had never specialized in machine tools, soon stumbled onto two unexpected difficulties. Reading data from punched cards was too slow to control machine tools operating at the speeds Parsons and the Air Force had in mind, and a machine tool cutting in three dimensions turned out to require an intimidating amount of data—far more than could be processed by Parsons's "cardamatic" system.

To solve the speed problem, MIT suggested encoding punched paper tape

instead of cards—a significant departure from Parsons's proposal. And to reduce the data-handling demand, the NC project turned to an esoteric system for translating dimensional data into trajectories for cutting tools. The system, an outgrowth of World War II gun-aiming strategies, was now being adapted by another Servo Lab group working on an aircraft simulator. Indeed, it's said that Prof. Jay Forrester, in charge of the so-called Whirlwind project, first sketched this application to machine tools on a paper napkin at lunch one day.

Parsons was upset by this excursion into technologies that were completely uncharted in the machine-tool industry. He was "overwhelmed by these fellows," he told Noble, and he proposed that MIT confine itself to a simpler version of his original problem—cardamatic control of a demonstration machine that would cut in only one dimension, like a saw. But Parsons was also "entranced by their mental capacity." So when the MIT group declined to compromise, he agreed to stay on to represent the industry's midsize companies such as his own in the work.

After 1952, when MIT gave the first demonstration of NC, Parsons backed away from the project, saying that the MIT concept was irrelevant to most machine-tool makers' needs. After spending most of the next year disseminating (selling, if you prefer) the concept and studying its possible impacts, the MIT group learned to its consternation that Parsons was not alone in that judgment. Numerical control found few takers; the economics bogged down in the complexity and cost of preparing the paper tapes.

This problem was resolved in 1959 by the Servo Lab's second major achievement in NC—an automatically programmed tool that permitted instructions to be presented in a simple, English-like language and that could be expanded as its users became more adept. The system was so easy to use that it "settled once and for all the issue of whether or not NC could be economically viable," writes Reintjes.

## A Contested Legacy

In the 1960s, an assortment of U.S.-made NC machines finally appeared on the market. They proved themselves almost at once. But after what Reintjes calls an "upbeat" decade for the machine-tool makers, the industry was consumed by overseas competition.

Contemplating this loss, Reintjes finds himself head-to-head with those who construe it as evidence that MIT's approach to numerical control was misguided. Noble argues that in failing to heed Parsons, MIT and the Air Force ignored the needs of most machine-tool makers, whose bread-and-butter work was building the modest tools that filled many U.S. factories. These makers knew nothing of complex digital systems, nor did they have the interest or resources to learn. And they did not aspire to operate the megamachines for which the Air Force intended NC. Seymour Melman, of Columbia University, has carried the same argument a step farther: the new technology forced manufacturers to turn to the large tools that only major companies could build, while the smaller makers were driven to bankruptcy and their workers to the street.

Not so, writes Reintjes. He argues that MIT's numerical control technology was not unnecessarily complex. Given the state of the art, there was simply no other way to go. Parsons's cardamatic concept was so basically flawed as to be a "nonissue," he writes. The fault lay instead with the traditional toolmakers, who were "steeped in conservatism" and reacted to MIT's new technology just as Parsons did. For example, says Reintjes, MIT in 1955 proposed to the National Machine Tool Builders Association a joint program that would have focused on the use of NC for simple operations such as drilling, boring, and riveting. The association's response was thanks but no thanks.

In Reintjes's view, the collapse of the U.S. machine-tool industry was tied not to the NC developments of the 1950s and 1960s but to the decline of all U.S. manufacturing in the 1970s. The industry's best customers let their technology

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stagnate. The result was a drop in process innovation—the toolmakers' best source of new orders, according to *Made in America*, MIT's 1989 study of productivity and competitiveness.

Yet perhaps the best argument against Noble's position is one that Reintjes implies but does not aggressively pursue. If MIT had restructured its numerical control project as Parsons suggested, it not only would have failed to meet his grossly simplified goal. Much worse, it would have deprived industry of some important technologies that were spun off from the NC work.

In the 1960s, MIT engineers applied the numerical dimensioning technology behind NC to computer-aided design and manufacturing. At the same time, others exploited these dimensioning concepts in graphics displays—for plotting and map making, for example—and in creating the lithographed integrated circuits that would spawn the computer revolution. James O. McDonough, who was a member of the Servo Lab's original NC group, asserts that without technology directly descended from MIT's numerical control project, "there is no conceivable way that today's integrated circuits could be made." The NC project, far from being a case of research that positioned itself too far above the market, is an example of exploiting, long before a conservative industry was ready to accept it, a basic technical concept with extraordinary implications.

Today most of us see only the end product of those implications. We are like Rip Van Winkle with respect to new technology: the slow progress, almost always incremental, is hidden from us. We simply awake one day to the reality of such remarkable developments as 767 transport aircraft, personal computers, and bar-code readers. Reintjes's achievement in *Numerical Control* is to bridge that gap for one technology—and to show how unpredictably large the results can be of pressing hard on a subtle new frontier. ■

JOHN I. MATTILL is editor emeritus of Technology Review.

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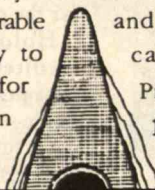
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# Notes

EDITED BY PHILIP LoPICCOLO



## Alternative Medical Training

While the medical community in the Western world is perhaps not ready to fully endorse meditation, homeopathy, clinical ecology, and Indian healing, at least one U.S. college, Tufts University School of Medicine, is encouraging students to explore these and other alternative approaches.

"Each of these medical systems is concerned with the patient as an entire person, rather than the narrow focus on disease we've adopted in the West," says Glenn Rothfeld, clinical instructor in family medicine, who teaches a course entitled "Complementary Healing Systems." He adds: "Because we treat one disease at a time, we have no way of asking, 'What aspect of his or her personality or life may be causing this?'"

If interest in the course is any indication, the next generation of doctors may be more receptive to holistic approaches and consequently offer patients a wider range of therapies, Rothfeld believes. With 28 students enrolled, the course is the single most popular elective at the school.

## Don't Peel That Grape

When French researchers reported a couple of years ago that a modest intake of red wine could lower cholesterol, many nondrinkers may have felt left out. But now research-

ers at Cornell have discovered that resveratrol—the chemical in red wine they believe is responsible for both lowering "bad" LDL-cholesterol levels and reducing the stickiness of blood platelets that clog arteries—is also plentiful in purple grape juice.

After analyzing 18 grape juice samples from three geographical regions, Leroy Creasy, a professor of pomology (the study of fruit growing) at Cornell, found that all had more resveratrol than half of the 30 red wines analyzed. None had as high a concentration as some red wines, however, particularly red Bordeaux. On average, each eight-ounce glass of grape juice contains a few millionths of a gram of resveratrol, says Creasy, which means a person would have to drink three to four glasses of juice to get as much of the chemical typically found in one glass of red wine.



Creasy found that resveratrol is a natural pesticide produced in grape skins to fight fungal disease. So only red wine, which unlike white wine is made from grapes fermented with their skins, and purple grape juice, which is made by heating and pressing whole Concord grapes, have high resveratrol concentrations.

Creasy's next project is to analyze other grape products for resveratrol, including jellies, jams, and raisins.

## Photon Tunnels

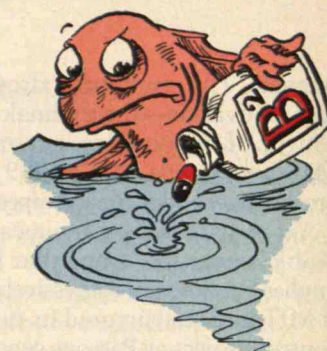
Creating a computer chip that uses photons rather than electrons to transmit data has been little more than a gleam in the eyes of computer designers for decades. But now researchers at the University of Illinois have taken an important step toward that elusive goal by designing a chip that can transmit light through microscopic tunnels that wind their way along circuit pathways.

Using a process similar to the one for designing circuits on silicon chips, electrical engineering professor Nick Holonyak and his colleagues are able to "grow" an oxide on the precisely etched surface of aluminum gallium arsenide. The oxide—formed when the exposed surface is subjected to temperatures of 750°F and high humidity—is so hard and smooth that when sandwiched between thin layers of gallium arsenide it creates durable, highly reflective passageways for the photon signals.

Holonyak—who is also credited with inventing the first practical light-emitting diode—has achieved promising results with a rudimentary chip design. His team and several others are working to refine the technique, which ultimately could lead to computers that operate at the speed of light and connect directly with fiber-optic-based communications systems. But Holonyak cautions that "to take full advantage of the new technology is a 10-year affair."

## Pollution-Busting Vitamin

A modified form of vitamin B<sub>2</sub> may be the newest prescription for combating water pollution. Researchers at the Institute for Environmental Studies in Champaign, Ill., have discovered that the compound,



riboflavin tetra-acetate (RTA), can act as a photocatalyst, harnessing sunlight to convert dissolved organic pollutants into other compounds.

A team led by environmental scientist Richard Larson first showed that in the presence of sunlight, ordinary vitamin B<sub>2</sub> (riboflavin) could break down pollutants such as anilines and phenols, which are related to herbicides that can leach into groundwater. The vitamin has similar effects on aromatic hydrocarbons, which are found in petrochemicals and industrial and municipal waste.

Riboflavin was shown to be 100 to 1,000 times better at degrading these pollutants than sunlight alone. But it is limited by its short life in the sun. "It's sort of a kamikaze compound," says Larson. "After five minutes, it has done what it can but has also destroyed itself."

By converting riboflavin to a more stable form, RTA, Larson and his colleagues were able to extend the effective life span by a factor of 10 to 20 without diminishing the original compound's photochemical properties.

"This is just the first step toward understanding the process of photochemically decontaminating water," says Larson. "Although the known toxins were removed, they were broken down into many intermediate compounds, not all the way down to CO<sub>2</sub>," he says. "The key question now is what happens to these intermediates."



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